SBIR

Small Business Innovation Research Program

ABSTRACTS OF AWARDS FOR FISCAL YEAR 1999

U.S. DEPARTMENT OF COMMERCE

INTRODUCTION

The Department of Commerce (DOC), through the Small Business Innovation Research (SBIR) program, awarded 40 Phase 1 contracts for FY 1999. These awards of up to $75,000 each, and totaling approximately $2.9 million, are for a 6-month effort to demonstrate the feasibility of innovative approaches to the research topics identified in the "DOC SBIR Program Solicitation for FY99 (DOC 99-1)." Abstracts of the successful Phase 1 proposals submitted under this solicitation, and brief comments on their potential commercial applications, are provided in this publication.

In Phase 2, funding is provided for projects that are most promising after Phase 1 is completed. These awards can be for up to $300,000 each and for 2 years. Phase 3 uses non-SBIR funding to pursue potential commercial applications of the project. The DOC awarded a total of 17 Phase 2 contracts in FY 99 for a total of approximately $4.6 million. Abstracts of successful Phase 2 proposals and comments on their commercial applications are also provided in this solicitation.

The SBIR program is highly competitive. A total of about 300 proposals were received by DOC in response to its FY 99 solicitation. The proposals were independently reviewed by DOC scientists and/or engineers. With the funds available, only 40 could be selected. Final selection was based upon the results of the reviews, relative importance to DOC needs, relationship to on-going research, and potential for commercialization.

FY 99 Phase 1 Award Winner

TOPIC:	8.1	Atmospheric and Hydrological Sciences
SUBTOPIC:	8.1.1A	Low-Cost Rugged Pressure Sensors for Large-Scale Deployment in Tornado-Prone Areas
TITLE:		A Hardened In-Situ Tornado Pressure Recorder
FIRM:		Applied Research Associates, Inc 4300 San Mateo Blvd., NE. Suite A220 Albuquerque, NM 87110
PRINCIPLE INVESTIGATOR:		Tim Samaras 303-795-8106
AWARD AMOUNT:		$74,934

ABSTRACT:

This proposed effort uses an innovative approach of a low-cost pressure probe designed by Applied Research Associates, Inc. (ARA) to address the difficult measurement problem of obtaining pressure signatures from the passage of tornado cores. Knowing the pressures associated with tornadoes could provide estimates of wind speeds in tornado cores. The Hardened In-Situ Tornado Pressure Recorder (HITPR) will provide accurate measurements in the presence of high turbulent wind conditions. The HITPR meets all of the needs in making this difficult measurement possible including survival in extreme winds of 90-140 m/s, tornado driven debris, extremely large hail, and flooding. The HITPR electronics are designed to survive significant electrical impulses associated with nearby lightning strikes, typical of severe storms.

The Phase 1 effort will consist of wind computer model refinements, final system design, and construction of a prototype HITPR. Phase 1 will also include testing and field deployments of the HITPR, and data collection/analysis. It is anticipated that Phase 2 would include further refinements on the HITPR based on performance data collected in Phase 1. Additionally in Phase 2, 7 to 10 deliverable units would be constructed and large-scale deployments of the systems in tornado-prone areas would be attempted.

COMMERCIAL APPLICATIONS:

The HITPR has a large commercial potential as the data collected from a large-scale deployment will provide the wind speeds from tornado cores based on measured pressure. It would be the only known method of providing this data on a large-scale basis throughout the tornado-prone areas of the United States. The data gathered would be used to enhance tornado research and make improvements to man-made structures for resisting tornado winds which would ultimately save lives. Potential customers would include the insurance industry, utility companies, and research organizations.

FY 99 Phase 1 Award Winner

TOPIC:	8.1	Atmospheric and Hydrological Sciences
SUBTOPIC:	8.1.4A	Microwave Remote Sensing of the Ocean Surface Wind Vector Using Passive Polarity
TITLE:		A Compact Airborne Passive Polarimetric for Ocean Surface Wind Vector Measurement
FIRM:		Quadrant Engineering Inc. 107 Sunderland Road Amherst, MA 01002
PRINCIPLE INVESTIGATOR:		Mark Goodberlet 413-549-4402
AWARD AMOUNT:		$75,000

ABSTRACT:

Quadrant Engineering Inc. seeks SBIR funding to develop a compact airborne conically scanning polarimetric microwave radiometer for imaging the ocean surface wind vector and retrieving rain rate. This system will be designed to be used on the NOAA WP-3D aircraft for hurricane reconnaissance missions. Existing radar-based wind remote sensing techniques suffer from poor sensitivity to wind speed at high winds. Satellite-based passive instruments suffer from poor spatial resolution and high attenuation due to precipitation. Recent experiments and studies have demonstrated that polarimetric radiometers may be more effective than radar techniques in measuring high winds. By choosing a comparatively low operating frequency, the radiometer can be made less sensitive to attenuation caused by precipitation. The proposed polarimetric radiometer will be designed to operate from instrumentation pods that can be easily attached to the wing of a NOAA P3 or other research air craft. A low profile, low loss dual-polarized pencil beam antenna that can be integrated into existing instrument pods is also proposed. This new system will offer a cost-effective approach to monitoring ocean surface wind field from aircraft, and will be designed to operate in the harsh conditions encountered during hurricane reconnaissance missions.

COMMERCIAL APPLICATIONS:

Applications of the proposed polarimetric radiometer include airborne hurricane reconnaissance and ocean wind monitoring by government agencies and the military.

FY 99 Phase 1 Award Winner

TOPIC:	8.2	Ocean Observation Systems
SUBTOPIC:	8.2.1A	Operational Ocean Instrumentation, Measurement and Data Assimilation Systems
TITLE:		An Approach to the Real-Time Measurement and Distribution of the Average Density of Harbor Water
FIRM:		Webb Research Corporation 82 Technology Park Drive East Falmouth, MA 02536
PRINCIPLE INVESTIGATOR:		Douglas C. Webb 508-548-2077
AWARD AMOUNT:		$72,613

ABSTRACT:

Density has an important effect on buoyancy and therefore the draft of ships. The availability of reliable, real-time density measurements would be an important advance in efficient harbor management and safe ship piloting, especially with the trend toward decreased keel clearances.

Phase 1 research proposes investigation of a small instrument package deployed on the harbor bottom and cable connected to shore. It will measure temperature, pressure, and round-trip travel time for a sonic wave to make the return trip to the surface reflection.

At a given temperature, pressure increases with density and sound transit time decreases with density. Both these measurements integrate the properties of the water column, and by using the temperature observed at the bottom, average density can be computed to the accuracy required. The basic measurements of pressure, transit time, and temperature can be made with existing, inexpensive, and well-proven technology. A microprocessor can filter, average, and process these basic observations into density data and transmit ashore by cable, with the same cable providing the modest power requirements of the bottom instrument. The resulting data flow would be a candidate for integration into existing PORTS installations.

In operation, the system can improve harbor traffic flow, decrease risk of groundings and provide environmental data for effective esturine management.

COMMERCIAL APPLICATIONS:

The proposed instrument will have world-wide application in harbor management and utilization. Its inherently low-maintenance technologies and bottom mounting make it will suited for long-term operation in the high fouling and traffic environments of ports.

FY 99 Phase 1 Award Winner

TOPIC:	8.2	Ocean Observation Systems
SUBTOPIC:	8.2.1.A	Operational Ocean Instrumentation, Measurement and Data Assimilation Systems
TITLE:		Radar Bridge Clearance Sensor
FIRM:		Technology Service Corporation 11400 West Olympic Blvd., Suite 300 Los Angeles, CA 90064-1550
PRINCIPLE INVESTIGATOR:		Charles A. Shipley 310-954-2200
AWARD AMOUNT:		$74,968

ABSTRACT:

TSC proposes a small, low cost, very low power, solid-state radar solution to the bridge clearance measurement problem. TSC has an existing radar, developed under internal R&D funds, intended for use in the agriculture community. It measures the exact distance from a harvester head to the soil below, through intervening foliage. TSC will modify the signal processing algorithms of this radar making it suitable for measurement of the distance form a bridge to the water surface below. Processing will filter out the effects of interfering phenomena, such as surface turbulence, waves, weather, and boats. Data output will consist of the real-time mean water height, and statistics including its standard deviation and extrema.

Phase 1 will include investigations of water scattering characteristics under various conditions. The signal processing required to determine water height will be developed and incorporated into the radar. Site-specific requirements to achieve unattended, all-weather, real-time operation will be investigated, including power source and data communication alternatives. Phase 1 will culminate in a demonstration of the prototype radar by measuring the ocean height and standard deviation below the local Santa Monica pier. The results will be compared to the operational NOAA water monitoring station #9410840, located at that site.

COMMERCIAL APPLICATIONS:

Several NOAA activities can make use of radar-based water level monitoring. For example, the Oceanographic Products and Services Division (OPSD) collects, analyzes and distributes historical and real-time observations of water levels and other oceanographic data. The shipping community can benefit from real-time assessments of bridge clearance and water depth.

TSC's baseline radar, which will be enhanced for this effort, is in demand by the agriculture industry to measure harvester head-to-ground distances. There are also several other applications of virtually identical technology.

FY 99 Phase 1 Award Winner

TOPIC:	8.2	Ocean Observation Systems
SUBTOPIC:	8.2.5A	High Resolution Hyperspectral System for Rapid Coastal Marine Geophysical Data
TITLE:		High Resolution Hyperspectral System for Rapid Coastal Marine Geophysical Data
FIRM:		Advanced Power Technologies, Inc. 1250 24th Street, NW, Suite 850 Washington, D.C. 20037
PRINCIPLE INVESTIGATOR:		George Keramidas 202-223-8808
AWARD AMOUNT:		$74,011

ABSTRACT:

The focus of this research activity is the complete design of an end-to-end airborne hyper-spectral imaging system optimized for measurements of the coastal and open ocean environments. The system will integrate an unsupervised spectral processing system with a PC based real time processing workstation for the rapid detection, discrimination and quantification of components affecting the water quality and in water visibility. The proposed system will be based on the currently operational TENCAP Real-time Image Processing Spectrograph (TRIPS) which was optimized for similar environments. The TRIPS sensor includes several off-the-self components and already satisfies many of the project's unique requirements greatly reducing cost and potential risk. A trade study will be conducted as part of the sensor design, to optimize the system flexibility for ocean applications. A novel blazing process for the TRIPS holographic grating will be incorporated in the design to improve optical efficiency and polarization insensitivity. The integrated autonomous hyperspectral processing system will be augmented with automated georegis-tration; rapid image display and radiometric calibration will also be addressed. An existing TRIPS sensor will be used to verify the expected performance of the final system.

COMMERCIAL APPLICATIONS:

Compact hyperspectral sensors with near real-time automated processing have enormous commercial value because of their broad applicability to medical imaging, mining and exploration, environmental monitoring, precision farming and industrial inspection. Accurate data compression is critical to the commercialization of technology due to the extremely high data rates produced by the sensors.

FY 99 Phase 1 Award Winner

TOPIC:	8.2	Ocean Science
SUBTOPIC:	8.2.7A	Ship Motion Measurement System Utilizing a GPS/IMU System
TITLE:		GPS / Inertial Ship Motion Measurement System
FIRM:		Seagull Technology, Inc. 16400 Lark Avenue Los Gatos, CA 95032
PRINCIPLE INVESTIGATOR:		John M. Wilson 408-358-7100
AWARD AMOUNT:		$75,000

ABSTRACT:

Ships and buoys with scientific instruments aboard need precise position, attitude and motion information. Motion compensation is necessary to obtain measurements from radars, acoustic instruments used in hydrographic survey and current profiling, and instruments mounted on towers. Precise attitude and velocity sensors such as large spinning-mass gyrocompasses or ring-laser gyros are very expensive and too large for use on smaller platforms like buoys or autonomous vehicles. Use of such systems on smaller ships of opportunity is usually impractical for reasons of cost and logistics.

Seagull Technology has developed GPS/Inertial attitude systems for aviation, marine and ground vehicle applications. Prototypes have proven precise and reliable in demanding flight tests and sea trails. We proposed to extend this GPS/Inertial technology to full 6-DOF capability, including attitude, position and velocity states. Extended optimal filtering algorithms will estimate and compensate for GPS and inertial sensor installation errors, and will be robust to GPS data dropouts. Performance will be enhanced using next-generation GPS hardware currently under development. The resulting GPS/Inertial Ship Motion Measurement System (SMMS) will be a rugged, low-cost 6-DOF sensor suitable for widespread use on vessels of all sizes, moored and drifting buoys and other platforms.

COMMERCIAL APPLICATIONS:

The GPS/Inertial Ship Motion Measurement System and follow-on products will serve vehicle sensing and control applications in numerous market segments. In addition to marine applications, worldwide markets for this capability include precision agriculture, precision mining, outdoor construction machinery and aviation, to name a few. Given the applicability of GPS Inertial measurements technology to a number of high-volume markets, we believe that the combined market potential for this technology is several hundred million dollars per year in the United States alone.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.1SG	Aquaculture: Developing and Improving Marine Species Culture
TITLE:		Enhancement of Gonad or Roe in the Green Sea Urchin Using Summer Photoperiod and Naturally Occurring Phytoestrogens in a Land-Based Aquaculture Facility
FIRM:		Acadia Seafood International 193 Clark's Cove Walpole, Maine 04573
PRINCIPLE INVESTIGATOR:		Michael Devin 207-563-3146 x 305
AWARD AMOUNT:		$49,002

ABSTRACT:

This SBIR Phase 1 project tests a pilot version of a land-based aquaculture facility for the green sea urchin (Stronglylocentrotus droebachiensis), a commercially imported species not previously cultured as adult organisms. We will develop an alternative technology for the New England fishery which now depends only on harvest of wild urchins. Sea urchin roe is a delicacy in Japan that is the basis of a 250 millions+ dollar fishery (Watts et al., 1998). Over fishing has devastated natural populations. High quality urchin roe is characterized be size, taste, color, texture and firmness. We will produce and evaluate a crop of sea urchins containing high quality roe (gonads) using the Lawrence urchin diet and by manipulating their gametogenic cycle by photoperiod and by a treatment with estrogen or the phytoestrogen, genestein. Our studies indicate that manipulation of diet can economically bring urchins gonads of low quality to high quality in 3 months, raising whole urchin prices from 70 cents/lb to $5.50/lb. In Phase 2 of this project, our understanding of diet and phytoestrogen effects obtained above and photoperiod manipulation of gametogenesis will be coupled to produce additional crops outside of the normal urchin reproductive season to coincide with other periods when demand is greater than supply. If adopted by the fishery, this innovative aquaculture effort would focus on high end product, use fewer animals to maximize profits and place considerable less stress on natural populations.

COMMERCIAL APPLICATIONS:

With success of both Phase 1 and 2 of our pilot program, we will build a new facility containing a 100 module system (700,000 urchins). At harvest from the wild, 7 urchins/lb gives 100,000lbs. These will cost 70 cents/lb or $70,000 to harvest. At sale, 5 urchins/lb yields 140,000lbs. Deducting 10% for mortality/sampling leaves 126,000lbs of salable urchins at $5.50/lb FOB Boston. Sale price per crop is $693,000. With additional crops resulting from diet and photoperiod manipulation, a yearly profit of $800,000 is anticipated. It is estimated that 10 such facilities could exist in Maine.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.1SG	Aquaculture: Developing and Improving Marine Species Culture
TITLE:		Innovative Fingerling Production Strategies for Yellow Perch Aquaculture
FIRM:		Coolwater Aquaculture P.O. Box 404 Cambridge, WI 53523
PRINCIPLE INVESTIGATOR:		Steve Genson 920-987-5900
AWARD AMOUNT:		$49,665

ABSTRACT:

The yellow perch is a highly valued food fish in the Great Lakes, and an important aquaculture industry is now developing to meet the high market demand for this species. The high cost of feed-trained fingerlings currently constrains the expansion of this industry. Most fingerlings are produced in ponds. There are significant problems, however, with slow growth, width size variation, and low production rates using current technologies. These problems result because some fish accept formulated feeds more readily than others, giving them an early growth advantage. These larger fish then cannibalize smaller fish, and deny them access to food.

The principle objective of this project is to develop novel processes for the production of yellow perch fingerlings in ponds. Three innovative approaches will be evaluated in Phase 1 to achieve this goal: (1) using vibratory sound to improve the attraction of fingerlings to automatic feeders, (2) reducing or eliminating natural food available to fingerlings, thereby compelling them to accept formulated diets, and (3) size-grading fingerlings to eliminate size variation, feeding hierarchies and cannibalism. In Phase 2 we will focus our efforts on combining and optimizing the methods that prove to be the most promising in our Phase 1 experiments, and conduct a detailed economic analysis.

COMMERCIAL APPLICATIONS:

Our proposed research will lead to the development of superior strategies for the commercial production of yellow perch fingerlings in ponds. We will develop methods to increase the size, uniformity and production of yellow perch fingerlings. Increased production efficiency will greatly reduce fingerling costs. This, in turn, will markedly increase the profitability of the yellow perch aquaculture industry, both for fingerling and grow-out producers, and help to greatly expand the yellow perch aquaculture industry to meet the current demand for this important Great Lakes species. The results may benefit other aquaculture industries, such as hybrid striped bass and walleye, that also rely on pond-reared fingerlings.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.5SG	Sensor Technologies for Measuring Microbiota
TITLE:		A Method to Aid in the Prevention of Ciguatera Fish Poisoning
FIRM:		Oceanit Laboratories, Inc. 1100 Alakea Street, 31st Floor Honolulu, HI 96813
PRINCIPLE INVESTIGATOR:		Joanne S.M. Ebesu 808-531-3017
AWARD AMOUNT:		$49,892

ABSTRACT:

The overall goal of this proposed project is to prevent human illness due to ciguatera toxins by creating an innovative method to detect these harmful toxins in fish before they are incidentally ingested. The new method will incorporate immunological and Raman spectroscopy technologies, enabling rapid, quantitative detection of ciguatera toxins suitable for large-scale testing. The method can be used by clinical laboratories to aid in the diagnosis of ciguatera cases and hence, to improve treatment for this disease. Oceanit Test Systems is geared to produce the essential component (Mab-CTX) of the Cigua-CheckTM kits. The research to be conducted in this Phase 1 effort will provide information on the validity of our CTX detection system, details on the specifications of the system, and clues on how to adapt the CTX detection system for large-scale commercial screening for other marine toxins in fish and other seafood. In addition, the method could also be used by commercial fisheries for large-scale screening of suspected fish species collected from endemic ciguatera areas. The CTX detection system would be accessible and easily operated by laymen as well as technical personnel. The method to be developed in this proposal will provide a unique, simple, rapid and effective CTX detection method suitable for large-scale commercial use.

COMMERCIAL APPLICATIONS:

The markets for such a kit would be similar to those for the Cigua-Check CTX detection kit: ciguatera-endemic areas such as Hawaii, Florida, Guam, the Philippines, Japan, and the Caribbean; consumers of seafood harvested in these areas as well as countries importing seafood from these areas; commercial and recreational fishermen; diagnostic laboratories; and restauranteurs. The use of the resulting commercial-scale ciguatera toxin screening method could be included in a Memorandum of Understanding (MOU) required as part of the Hazard Analysis and Critical Control Point (HACCP) program enforced by the US Food & Drug Administration. The HACCP program, recently approved in December 1997, was designed to ensure seafood. Foreign processors or exports of fish in endemic ciguatera countries or regions could include the Cigua-dart for CTX and thus open markets previously closed due to possible ciguatera contamination.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.5SG	Sensor Technologies for Measuring Microbiota
TITLE:		Automated Instrument for RNA-based Identification of Marine Microorganisms
FIRM:		TACAN Corporation 2330 Faraday Avenue Carlsbad, CA 92008
PRINCIPLE INVESTIGATOR:		Jeffrey T. Ives 760-438-1010
AWARD AMOUNT:		$49,847

ABSTRACT:

Marine pathogens have significant environmental and regulatory impacts on natural fisheries and aquacultue operations. Factors such as sewage and agricultural runoff, pollution, and xenobiotocs aggravate the conditions even more, so modern fisheries research is increasingly investigating the complex role of marine bacteria and viruses. Unfortunately, the time, personnel, and laboratory requirements of current culture-based assays severely limit studies of specific pathogens and their complex, interrelated roles. To overcome this problem and provide a fieldable, robust system for identifying specific microorganism species, this proposal describes development of a unique automated system for nucleic acid analysis. Microorganisms will be physically disrupted with a novel electromagnetic method, ribosomal RNA will be isolated by hybridization to specific oligonucleotides, and flourescently-tagged hybridization duplexes will be detected with compact, optoelectronic instrumentation. Targeting ribosomal RNA provides a number of advantages in terms of intrinsic amplification, species and strain specific sequences, and durable field operation. In contrast to cell culture and enzyme amplification processes, the proposed approach supports versatile operation over a broad range of marine, estuary, and freshwater environments. The low cost, easily operated instrument will enable researchers, regulators, and affected businesses to accurately determine the presence and type of potential hazard.

COMMERCIAL APPLICATIONS:

The proposed species identifier would be a significant benefit to state and federal health regulators, fisheries researchers, and businesses such as fisherman and markets involved in the distribution of marine fish and shellfish. Related markets would include water treatment facilities and agricultural testing for non-marine plants and animals. The primary advantages offered by this technology are lower cost, more rapid results, and species-specific identification.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.5SG	Sensor Technologies for Measuring Microbiota
TITLE:		Identification and Detection of Pathogens in Water Via Global Molecular Characterization and Flexible Test-targeting
FIRM:		Biosphere Genetics, Inc. P.O. Box 9528 Berkeley, CA 94709
PRINCIPLE INVESTIGATOR:		Lawrence A. Riggs 510-531-4848
AWARD AMOUNT:		$49,917

ABSTRACT:

The need to identify multiple targets for measurement and monitoring is common to many problems in the detection of human, fish, and shellfish pathogens. We propose to integrate knowledge and instrumentation for the purpose of: (a) allowing periodic broad-scope assessment of entire panels of pathogens; (b) increasing both flexibility and specificity in the targeting of organisms for routine testing; and (c) diminishing the cost of surveillance. Products of DNA amplification of a given genetic locus from all members of an assemblage will be examined with increasingly automated systems that can separate such sequences and permit rapid generation of sequence information diagnostic of individual members of evolutionary-related organisms. The powerful Denaturing High Performance Liquid Chromatography platform (Transgenomic technology) will be tested for the separation of highly similar PCR products, and automated peak recovery will allow rapid acquisition of sequence information.

COMMERCIAL APPLICATIONS:

Potential commercial applications exist in fish and shellfish health monitoring, environmental conditions surveillance in culture systems, and in seafood safety assurance. At the successful conclusion of Phase 1 research, we expect to have demonstrated that whole groups of microorganism (microbial consortia) can be characterized by techniques either partially automated at this time or subject to automation in Phase 2. We anticipate that by the end of Phase 2, hybridization probes designed from sequences obtained either by DGGE or D-HPLC fractions will be able to be used to conduct assays for microbial pathogens in the field, using portable instruments now under development by our research partners.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.7SG	Alternative Technologies to Ballast Water Exchange
TITLE:		Electrochemically Generated Ozone for On-board Control of Nonindigenous Invasive Species in Ballast Water
FIRM:		Lynntech, Inc. 7610 Eastmark Drive, Suite 202 College Station, TX 77840
PRINCIPLE INVESTIGATOR:		Thomas D. Rogers 409-693-0017
AWARD AMOUNT:		$50,000

ABSTRACT:

An onboard treatment technology for control of nonindigenous species in ballast water is the most practical approach to reducing the risk of introduction into U.S. waters. Ozone is equally effective or better than chlorine, hydrogen peroxide and several biocides which have been evaluated. Logistically, ozone is generated at the point of use whereas other chemicals must be transported and stored. To date, ozone has not been considered as practical because the corona discharge method of generation is not suitable in marine environments unless elaborate means are employed to protect against salt air and humidity. Electrochemically generated ozone solves this problem because no air is involved, and the marine environment does not affect the process. This project will demonstrate the advantages of high concentration electrochemically generated ozone in a field test to treat water from Lake Moody, Ontario (near Niagra Falls), which contains zebra mussel veliger and other species representative of ballast water. A marine biologist with industrial experience on zebra mussels and a Great Lakes ship captain will serve as consultants. An Environmental Compliance Officer of a world-wide shipping company and the Vice President of a ship building and repair company are also involved. This technology has a high potential for economical adaptation to on-board ballast water treatment.

COMMERCIAL APPLICATIONS:

Electrochemically generated ozone is an order of magnitude higher in concentration than ozone produced by air fed coronas. Corona discharge systems are not in widespread use in marine environments. Electrochemical ozone generation pioneered by Lynntech, Inc. is now at the commercial stage and is ideally suited for operation in marine environments. These systems have a small foot-print and have a high potential for use on-board ships or in other marine environments. The team assembled to assess the feasibility of this project bring comprehensive technical and economic expertise to this project in terms of future commercialization.

FY 99 Phase 1 Award Winner

TOPIC:	8.4	Ocean Sciences
SUBTOPIC:	8.4.10A	Polarimetric Infrared Imager
TITLE:		Polarimetric Infrared Imager
FIRM:		Aerodyne Research, Inc. 45 Manning Road Billerica, MA 01821
PRINCIPLE INVESTIGATOR:		Frank J. Iannarilli 978-663-9500 x 276
AWARD AMOUNT:		$75,000

ABSTRACT:

NOAA has continuing responsibilities to measure ocean near-surface roughness, since it strongly impacts retrieval and interpretation of other remotely sensed quantities of interest, such as surface temperature, wind speed, intrinsic color, etc. The spatial correlation length of wave slope, on the order of 5 cm indicates optical measurement as the most appropriate roughness retrieval technique. Optical techniques employed to date each suffer from drawbacks which can be overcome by passive IR polarimetric imaging.

Within out proposed Phase 1 effort, Aerodyne Research will formulate an experiment design and test plan for a surface-based ocean measurement demonstration employing the Air Force IR Polarimetric Hyperspectral Imager (IRPHSI), perform a field demonstration and data collection locally, confirm and quantify the wave slope and geophysical retrieval effectiveness, and evaluate preliminary sensor design adaptations for cost afford ability. The anticipated Phase 2 effort would deliver a complete and fully fieldable sensor system to NOAA. This system would include both the sensor and appropriate PC-based data acquisition and wave slope retrieval software.

COMMERCIAL APPLICATIONS:

Monitoring of waste products, coastal monitoring, search and rescue, vehicle tracking.

FY 99 Phase 1 Award Winner

TOPIC: 8.6. Adaptive Learning Systems

SUBTOPIC: 8.6.1T Web-based Instructional Platforms

TITLE: Adaptive Learning in Web-Based Instructional Systems

FIRM: Intelligent Systems Technology, Inc.
2800 28th Street, Suite 306
Santa Monica, CA 90405

PRINCIPAL INVESTIGATOR: Azad Madni
310-581-5440

AWARD AMOUNT: $74,891

ABSTRACT:

Recent advances in information technologies, and more specifically, in web-based instruction, intelligent tutoring systems, and platform-independent implementations have made it possible for the first time to create web-based instructional systems with the capability to adapt instructional sequence, and presentations based on learner/student progress and entry level skills. The specific thrust of this SBIR is intelligent authoring and knowledge management in web-based instructional systems. The product of Phase 1 will be a conceptual prototype that communicates the Phase 2 functionality and features to end-users and sponsors for feedback and critique.

COMMERCIAL APPLICATIONS:

Potential commercial applications of the research include web-based distance learning/training for packaged application suites such as ERP systems, manufacturing execution systems, and decision support systems.

FY 99 Phase 1 Award Winner

TOPIC:	8.7	Advanced Building Materials and Systems
SUBTOPIC:	8.7.5T	Measurement of Thermal Conductivity of Insulation at High Temperature
TITLE:		High Temperature Thermal Conductivity Apparatus
FIRM:		MetSys Corporation P.O. Box 317 Millwood, VA 22646
PRINCIPAL INVESTIGATOR:		Daniel Flynn 540-837-2186
AWARD AMOUNT:		$75,000

ABSTRACT:

It is proposed to develop an advanced-design guarded hot plate apparatus that will define the new state of the art for measuring the thermal conductivity of industrial insulation materials over the range of temperatures from 200 to 1500 K, depending upon the particular material and its compatibility with other materials. The apparatus will have the capability to carry out measurements under controlled environments of air, selected gases, or vacuum, again depending upon material compatibility. The specific technical objectives of the Phase 1 development effort are to: develop performance criteria and specifications for the apparatus; review alternative measurement approaches, select the design, and refine it to the point where it can be subjected to detailed analysis; develop numerical and analytical models of the apparatus that will enable reliable prediction of apparatus performance and measurement accuracy as functions of the design parameters; study and analyze alternative approaches to the most crucial design features of the apparatus; and develop a detailed design of the complete prototype apparatus to be built in Phase 2, and all instrumentation and software specifications.

COMMERCIAL APPLICATIONS:

Industrial plants and utilities account for about half of the total United States energy use. It has been estimated that over 1.4 quadrillion Btu's could be saved if industry installed economically optimal insulation. The apparatus to be developed under this project will provide the U.S. with an unparalled capability to provide accurate thermal conductivity data to manufacturers and users of high-temperature thermal insulations for a wide variety of industrial and military applications, thus allowing selection and installation of greatly improved insulation systems.

FY 99 Phase 1 Award Winner

TOPIC: 8.8 Advanced Detection and Suppression of Fires

SUBTOPIC: 8.8.1T Advanced Detection and Monitoring of Fires

TITLE: Novel Fiber Networked Diode Laser-Based Fire Detection

FIRM: Physical Sciences, Inc.
20 New England Business Center
Andover, MA 01810-1077

PRINCIPAL INVESTIGATOR: William Kessler
978-689-0003

AWARD AMOUNT: $74,985

ABSTRACT:

Physical Sciences Inc. proposes to develop and demonstrate a fiber optic network of sensors for the detection of molecular species and smoke used as fire indicators. The combination of these two sensors in one package will preclude false alarms while providing rapid, sensitive fire detection. The all-fiber network will use absorption measurements for toxic gases and scattering measurements for the presence of smoke. Diode laser-based absorption spectroscopy utilizing near infrared light sources has been developed and refined now for more than 10 years. We propose advancing this technology to the next logical stop by integrating a diode laser-based carbon monoxide sensor and scattering smoke sensor with an *all-fiber-optic* network for transmission of the laser light to and from the measurement point. The use of the same fiber optic components for laser launch and reception reduces the cost of diode laser-based fire sensors for widespread commercial application. We envision a central hub location for the main sensor control networked to an array of sensors which may be located within an individual building, an industrial park, or an entire community.

COMMERCIAL APPLICATIONS:

We anticipate that the demonstrated fiber optic network of sensors may lay the foundation for a new class of fire sensors which provide fire and toxic gas detection capability for both the business community and communities of homeowners. The use of currently developed telecommunications products and new products about to come on-line in the telecommunications industry make it possible to envision fire and carbon monoxide sensor companies servicing businesses and individual homeowners in the coming years.

FY 99 Phase 1 Award Winner

TOPIC:	8.10	Condition-Based Maintenance
SUBTOPIC:	8.10.1T	Development & Integration of Condition-Based Maintenance Technologies
TITLE:	Vigilant:	A Conditional-Based Maintenance Technology for Turbomachines
FIRM:		The Athena Group, Inc. 3424 N.W. 31st Street Gainsville, FL 32605
PRINCIPAL INVESTIGATOR:		Iztok Koren 352-371-2567
AWARD AMOUNT:		$75,000

ABSTRACT:

Condition-based maintenance (CBM) is concerned with ensuring the health of high-value systems. CBM is an evolving maintenance paradigm anticipated to play a major role in defining the operational environment of future complex machines. Such machines will be expected to possess deeply embedded diagnostic systems having predictably accurate real-time performance. A system with these capabilities would decrease operational costs and increase public safety. In this context, the Athena Group proposes Vigilant, a new class of embedded CBM system. The Vigilant paradigm is based on the innovative use of wavelets, neural classifiers, and data fusion techniques. By using multiple wavelet bases, the unresponsiveness of Fourier or single wavelet basis systems can be mitigated. Vigilant also incorporates a new data fusion and classifier design that overcomes the historical problem of training systems in the absence of meaningful failure databases. Preliminary studies have demonstrated the potential advantage of the Vigilant CBM in turbomachine applications. The Phase 1 SBIR study builds upon this foundation to produce an experimental prototype system that can be studied using computer simulations. The result is the definition of a viable Vigilant system which can be reduced to a field-operable prototype in Phase 2, and a commercial product in Phase 3.

COMMERCIAL APPLICATIONS:

CBM, while being an accepted maintenance paradigm, has had only limited commercial success. Vigilant expects to achieve a marketplace success in this area due to the technology's superior performance and cost-effectiveness. In commercial form, Vigilant will be delivered as a software system or upgrade. The marketing of Vigilant will benefit from the proposer's long-term technology relationship with Lockheed-Martin, a major provider of large complex machines.

FY 99 Phase 1 Award Winner

TOPIC: 8.11 Intelligent Control

SUBTOPIC: 8.11.3T Graphical Design of Manufacturing Control Systems

TITLE: Architectural Patterns for Real-Time Systems

FIRM: Real-Time Innovations, Inc.
155A Moffett Park Drive, Suite 111
Sunnyvale, CA 94089

PRINCIPAL INVESTIGATOR: Rajive Joshi
408-720-8312

AWARD AMOUNT: $75,000

ABSTRACT:

Software architecture is critical for real-time systems. Much progress has been made in generic architectures and reference models; the NIST ISAM system presents a well-developed theory of temporal hierarchical modeling to structure real-time systems. However, generic architectures have not realized their potential for widespread adoption.

We believe this is largely due to a lack of enabling software tools. We propose to develop a capability to define and enforce architectural patterns, and merge it with a commercial software design environment for intelligent control. The tool will assist in defining the architecture, building compliant systems, and developing and reusing software modules. Architects will use patterns to specify generic system structures. Users will then create complex systems by filling in these templates. The tool will provide the much-needed mechanism for widespread use of reference architectures.

COMMERCIAL APPLICATIONS:

The proposed research will create a platform that will serve as a technology conduit for architectures, modules, and research. With a powerful development environment behind it, reference model architectures will realize the potential of long years of research. This research, if successful, will revolutionize the development of intelligent control systems.

FY 99 Phase 1 Award Winner

TOPIC:	8.11	Intelligent Control
SUBTOPIC:	8.11.5T	Novel Atomizer for Control of Reference Spray Combustion Facility
TITLE:		A Micromachined Device for Precision Atomization
FIRM:		Creare Incorporated P.O. Box 71 Hanover, NH 03755
PRINCIPAL INVESTIGATOR:		James J. Barry 603-643-3800
AWARD AMOUNT:		$74,755

ABSTRACT:

To assist NIST's development of a reference spray combustion facility, we propose a novel atomizer based on a micromachined droplet generation device. This atomizer will provide precise and repeatable droplet fields, and its unique design permits control of droplet size distribution and spray output independent of air flow. We have previously demonstrated in the laboratory the basic approach for generating near-monodisperse droplets for production of precision aerosols. In Phase 1, we will demonstrate the generation of a specified droplet distribution using a proof-of-principle benchtop device and develop a concept design for a Phase 2 prototype. Phase 2 will involve constructing the prototype device, testing it in the lab, then installing and testing the atomizer in the NIST combustion facility.

COMMERCIAL APPLICATIONS:

The end result of Phase 1 and 2 will be a precision atomizer ideally suited to the needs of NIST's reference facility. The technology has strong prospects for commercialization in combustion and in material processing applications requiring precise, well-controlled droplet distributions.

FY 99 Phase 1 Award Winner

TOPIC:	8.11	Intelligent Control
SUBTOPIC:	8.11.7T	Process Monitoring and Control of Composites Processing
TITLE:		Optical Coherence Tomography Based Fiber Optic Sensor for Monitoring and Control of Composites Processing
FIRM:		Optiphase Inc. 7652 Haskell Avenue Van Nuys, CA 91406
PRINCIPAL INVESTIGATOR:		Pepe Davis 925-876-8818
AWARD AMOUNT:		$74,132

ABSTRACT:

An optical coherence tomography (OCT) based fiber optic sensor can provide non-invasive, high resolution, monitoring for control of composites processing in commercial manufacturing. OCT is a non-contact optical technique for imaging in scattering media such as glass reinforced composites. With <30 micron resolution achieved by OCT, microstructure and effects such as: fiber wetting, void structure, fiber orientation, fiber waviness, cracks and delaminations of composites can be determined. To commercialize this technology, a compact, robust, portable, and inexpensive OCT system must be designed and built which is insensitive to birefringence artifacts observed in typical OCT systems. Optiphase Inc. proposes to develop an innovative, all fiber optic OCT system utilizing a unique piezoelectric fiber optic modulator and a polarization sensitive design. Polarization sensitivity eliminates birefringence shadowing and artifacts and provides material strain information. The all fiber optic design provides compactness, ruggedness, portability and cost savings over bulk optic or hybrid systems. The project objectives are to design, build, and test this all fiber optic OCT sensor. These objectives will be met through analytical design and prototype testing culminating with imaging of glass reinforced composite samples at Lawrence Livermore National Laboratory.

COMMERCIAL APPLICATIONS:

The ruggedness, compactness, low cost, and non-invasive nature of an all fiber optic OCT system make this sensor applicable to monitoring, control, and automation of manufacturing processes and health monitoring of composites. In particular, an all fiber optic OCT sensor will be instrumental in monitoring microstructures during mold filling, predicting permeability for modeling of Liquid Composite Molding (LCM), and detecting damage such as cracks and delaminations of parts in the field. All these applications are specially pertinent to the automotive and marine composite industries. Additional commercial applications exist in the medical fields as a diagnostic tool for imaging of biological tissue such as the human retina, skin, blood vessels, and tooth and gums.

FY 99 Phase 1 Award Winner

TOPIC: 8.11 Intelligent Control

SUBTOPIC: 8.11.9T Sensor for In-Situ Measurements of Thermal Spray Coatings

TITLE: Investigation of Ripple-Technique for Thermal Spray Coatings

FIRM: STRATONICS, Inc.
23151 Verdugo Drive, Suite 114
Laguna Hills, CA 92653

PRINCIPAL INVESTIGATOR: James Craig
949-461-7060

AWARD AMOUNT: $74,999

ABSTRACT:

Thermal spray coating (TSC) is a promising low-cost technology for improving the abrasion resistance and surface characteristics of low cost parts. The major problem preventing wider adoption of this technology, is that coating quality is very sensitive to the surface temperature of the substrate during deposition. Application of the ripple technique for the simultaneous measurement of sample emissivity and temperature to TSC will be investigated. All major sources of error will be identified. Experiments will be designed and carried out to quantify the magnitude of the possible errors. Special fixtures will be designed and constructed for these experiments. It is expected that a major source of error will be associated with the necessity to measure the TSC deposition-sample temperature through the TSC flame. Measurements will be made during operation of the TSC flame both with and without typical TSC deposition samples as a function of flame temperature, velocity, particle leading, and sample temperature, when applicable, to quantify this source of error. A second source of error is the failure to satisfy Kirchhoff's law with the ripple-technique lamps. Measurements will be carried out as a function of ripple-technique lamp location to quantify these errors.

COMMERCIAL APPLICATIONS:

The proposed ripple technique temperature measurement system addresses industry's needs to simultaneously measure emissivity and temperature in thermal spray coating processes. This product is well suited for researchers in national laboratories, universities and industries who are developing and improving TSC. Successful completion of the proposed Phase 1 and Phase 2 research will increase the market for optical-fiber thermometers and the associated instrumentation that supports the ripple technique. Currently, this market is confined to the application of the ripple technique to rapid thermal processing (RTP) of integrated circuit wafers.

FY 99 Phase 1 Award Winner

TOPIC:	8.11	Intelligent Control
SUBTOPIC:	8.11.10T	High-Speed Video Camera for Measurements in Spray Processing
TITLE:		Intelligent Control
FIRM:		The Cooke Corporation 600 Main Street, P.O. Box 888 Tonawanda, NY 14150-0888
PRINCIPAL INVESTIGATOR:		Gerald Lilly 248-332-5655
AWARD AMOUNT:		$65,000

ABSTRACT:

A need has been identified for a High Speed Video camera for the study of high velocity particles used in thermal spray applications. Cooke Corporation proposes to build on our past success in the area of high speed imaging of thermal sprays, by extending the capabilities of our video camera system. The proposed camera will have extended spectral range to allow imaging of sprays below 600°C, while shortening exposure times to less than 50ns to enable the study of higher velocity sprays than previous systems. The camera will also provide multiple exposures per frame, with readout rates of 30 fps or lower as required. Spatial resolution of 10 : m or less will enable the imaging of fine droplets. All system parameters will be software controlled. The system will be robust, to allow operation in industrial environments. Deployment of the proposed high speed imaging system will further the research necessary to advance the industrial applications of spray forming in the industrial, military and automotive sectors. System costs will be minimized by extending the capabilities of existing commercial products.

COMMERCIAL APPLICATIONS:

The proposed system can be further developed to provide real time, feedback control of particle size, speed and distribution in thermal spray application systems. The proposed camera technology also lends itself to high speed imaging pyrometry for temperature studies of fast phenomena. Other applications include combustion and fuel injection studies, ink jet spray analysis, wind tunnel studies for aerodynamics and studies for a number of other spray related phenomena.

FY 99 Phase 1 Award Winner

TOPIC: 8.12 Intelligent and Distributed CAD

SUBTOPIC: 8.12.3T/CC Green Engineering Concepts for Next Generation Vehicles

TITLE: Green Engineering Concepts

FIRM: Thar Designs, Inc.
730 William Pitt Way
Pittsburgh, PA 15238

PRINCIPAL INVESTIGATOR: Lalit Chordia
412-826-3939

AWARD AMOUNT: $74,950

ABSTRACT:

Montreal Protocol requires that ozone-depleting gases such as clorofluorocarbons (CFC) should no longer be used soon. As an example, automobile air conditioning systems, with over 40-45 millions cars being fitted with air conditioners every year, represent a major source of refrigerant emissions to the environment. Replacing freon with carbon dioxide would be the ideal situation as was done in the early part of this century. This problem represents a unique opportunity to design and develop a new compressor based on Green Engineering. Green Engineering is the encapsulated applied research and design of systems that can impact the ecology at a significant level.

Designers have to utilize a vast array of design tools in order to develop a given product. The design team involved in Green Technologies has in addition to the typical design process: layer's of scientific, regulatory, and ethical data to address. Green Technology Designers need a Coupled Component Design System that has an accessible source of information related to their project, and the most current, authoritative, and extensible knowledge base with which to focus the design process. The design, and analysis tool set must be advanced and scaleable in order to disseminate and incorporate each component to its specification within the design. A collaborative exchange of information is extremely necessary for the design team to assure a timely development of design tools admission into the design repository.

COMMERCIAL APPLICATIONS:

With over 40-45 million air conditioned cars being made each year, even a small market share will make a significant dent in the emissions to the environment. The long-term market potential for compressors in the automotive industry is over $1.2 billion dollars annually, and this is expected to grow as the demand for cars fitted with air conditioners grows every year. This product is especially attractive in the developed countries due to environmental considerations and in third world countries due to the high cost of HCFC's. Once this process is proved for this application, it can be extended to other applications.

FY 99 Phase 1 Award Winner

TOPIC: 8.13 Infrastructure for Distributed Electronic Commerce

SUBTOPIC: 8.13.5T Natural Language Interface to 3-D Character Animations

TITLE: Conversational 3-D Character On-Line Agents

FIRM: Seamless Solutions, Inc.
3504 Lake Lynda Drive, Suite 390
Orlando, FL 32817

PRINCIPAL INVESTIGATOR: Edward Sims
407-737-7309

AWARD AMOUNT: $74,707

ABSTRACT:

This SBIR Phase 1 project will demonstrate the feasibility of real-time, natural language interaction with an Internet-based 3D Virtual Human Agent that can demonstrate the features, operation, maintenance, and assembly of new products. This project will be: (1) developed to operate on low-cost PC hardware; (2) demonstrated in a standard Internet browser environment, using VRML 97; (3) fully consistent with the standards being developed by the Humanoid Animation (H-ANIM) working group of the VRML consortium; and (4) coordinated with the initiatives being undertaken by the Natural Language Processing Animation (NLP-ANIM) and other working groups dedicated to developing related standards. In Phase 1, we will design and integrate a Test Bed that leverages existing hardware and software, and will perform trade studies on the proposed architecture, using a simple operator or maintenance task. We will also demonstrate the ability to compose new, more complex character interactions from basic library animations. In Phase 2, we will use the research results and Test Bed from Phase 1 to develop a fully operational prototype of a Natural Language Processing/Virtual Human (NLP/VH) agent that (1) demonstrates the features, operation, maintenance, and assembly of a product; and (2) learns new tasks by composing them from a library of basic animations.

COMMERCIAL APPLICATIONS:

A Conversational 3D Character On-line Agent, that demonstrates products and tasks in response to natural language commands, can enable new modes of communicating product information over the Internet. By providing a faculty to learn new, composite actions, the VH Agent will be adaptable to new tasks and situations. When linked with on-line learning, distributed manufacturing, e-commerce, and entertainment software, the same NLP/VH Agent can provide an immediacy and flexibility of interaction not available with “point and click” or joystick type controls.

FY 99 Phase 1 Award Winner

TOPIC: 8.13 Infrastructure for Distributed Electronic Commerce

SUBTOPIC: 8.13.10T Displays for Learning Technologies and Information Dissemination

TITLE: Evaluation and Integration of a Novel Volumetric 3D Display Technology

FIRM: Genex Technologies, Inc.
10605 Concord Street, Suite 500
Kensington, MD 20895

PRINCIPAL INVESTIGATOR: Jason Geng
301-962-6565

AWARD AMOUNT: $75,000

ABSTRACT:

Genex Technologies, Inc. (GTI) has recently made a breakthrough in high-resolution volumetric three-dimensional (3D) display technology by offering volumetric 3D display capability of over 8,000,000 voxels. Capitalizing upon our success, and facing new challenges brought by this innovation, we propose herein a Phase 1 SBIR program to: (1) perform a thorough evaluation of this novel volumetric 3D display technique in the context of human-display interface standards; and (2) develop a prototype volumetric 3D display device that integrates the powerful volumetric 3D capability with image storage and interactive user interface functions to enhance knowledge acquisition, comprehension, and management.

COMMERCIAL APPLICATIONS:

The commercial market for true 3D display systems is sizable (the market for compatible 2D display was about $22 billion/year in 1995 and is continuously growing) and applications are enormous, including both military (e.g., air traffic control, pilot training, battle management, submarine navigation, telemedicine, etc.) and commercial (e.g., 3D TV, virtual reality, computer aided design, visualization of multidimensional data, medical imaging, surgery assistance, education, scientific computing, video games, stadium displays, etc.). The 3D display system will provide a new level of realism and literally add a new dimension to the dynamic interaction between human, display, and computers.

FY 99 Phase 1 Award Winner

TOPIC: 8.13 Infrastructure for Distributed Electronic Commerce

SUBTOPIC: 8.13.11T Security Requirements Analysis, Methods and Tools

TITLE: Security Requirements Analysis, Methods and Tools

FIRM: VDG, Inc.
6009 Brookside Drive
Chevy Chase, MD 20815

PRINCIPAL INVESTIGATOR: Serban Gavrila
301-975-4343

AWARD AMOUNT: $74,972

ABSTRACT:

The research proposed herein is intended to solve two problems, namely (1) to define a method for the analysis of protection profiles (e.g., those of the Common Criteria for IT Security, FIPS 140 series) for distributed systems, networks, and their subsystems in a precise and systematic manner; and (2) to provide a set of automated tools to support profile development and analysis. Precise analysis methods and tools for profile requirements and components have not been available because a formal basis for classifying and analyzing the dependencies among these requirements and components does not exist to date. Furthermore, a systematic way of composing security components into a profile in a manner that enables the demonstration of their effectiveness in countering a specific set of threats is also lacking. While useful in practice, extant profile development tools are in effect simple aids for the display, manipulation, storage, and formatting of textual requirements. These tools do not satisfy our profile development, analysis and effectiveness goals. The overall objective of this project is to develop a precise method and a set of tools for the analysis and synthesis of protection profiles, and for the specification of security targets based on a wide variety of security-requirement sets of different sizes and complexity.

COMMERCIAL APPLICATIONS:

The profile development and analysis method and tools, when fully implemented, will provide a significant measure of confidence in consistency, completeness, and effectiveness of protection profiles and security targets. We envision that the method and tools would be used for the development and analysis of new protection profiles by both private industry, government, and commercial security certification services both in the U.S. and internationally, for both the Common Criteria and other, more specialized, security standards, e.g., cryptographic frameworks.

FY 99 Phase 1 Award Winner

TOPIC: 8.15 Measurement & Standards for Composite Materials

SUBTOPIC: 8.15.1T Methods & Tools to Support Composite Materials for Civil Infrastructure

TITLE: Low Cost Renewable Resin for Pultruded Products

FIRM: Composite Products, Inc.
9417 South Broadway, Suite 110
St. Louis, MO 63125

PRINCIPAL INVESTIGATOR: John Unser
314-638-6525

AWARD AMOUNT: $74,977

ABSTRACT:

One of the fastest growing industries is the civil infrastructure. Composites usage represent only a small percentage of the civil infrastructure market. In 1997, composite material shipments to this market were 700 million pounds. In just September of 1998, steel shipments in this market were 2.4 billion pounds. One of the main reasons for the small penetration of composites into this market is that they are too expensive. Two of the major cost drivers for composites are labor and raw materials. Labor costs can be reduced significantly through the use of pultrusion, which is a continuous low cost fabrication method for composites. However, there has not been much focus on the development of low cost, high performance raw materials for use on composites. The use of renewable raw materials such as Epoxidized Soybean Oil in resin formulations offer low cost ($.50 per pound) raw materials. Another problem with composites is that they are not ductile, therefore they fail catastrophically. Epoxidized Soybean Oil in resin formulations offer damage tolerance, ductility, and flexibility. Composite Products Inc. (CPI) and the University of Missouri - Rolla have teamed to propose to develop a new resin system for pultrusion base on this renewable raw material source. Preliminary work indicates that a pultrudable resin system can be made that is more ductile without much loss in strength.

COMMERCIAL APPLICATIONS:

The potential uses of pultruded composite products that are strong, damage tolerant, and flexible are numerous. CPI envisions implementation in applications where catastrophic failure could be life threatening such as hand railings in industrial sites, safety rails for off shore platforms, deck railing systems for boats, and road barriers. CPI is currently building several all composite bridges in Missouri. CPI will focus on the development of road barriers, which is a natural extension of the bridge effort.

FY 99 Phase 1 Award Winner

TOPIC:	8.15	Measurement & Standards for Composite Materials
SUBTOPIC:	8.15.2T	Flow Detection Method for FRP Composites Used to Repair Concrete and Masonry
TITLE:		NDE of FRP Repairs for Concrete and Masonry
FIRM:		Texas Research Institute Austin, Inc. 9063 Bee Caves Road Austin, TX 78733-6201
PRINCIPAL INVESTIGATOR:		George Matzkanin 512-263-2101
AWARD AMOUNT:		$74,997

ABSTRACT:

Adhesively bonding fiber reinforced polymer (FRP) materials to concrete and masonry structural components has emerged as a valuable way to repair America's aging infrastructure. Widespread use of this technology is hampered, however, by the current inability to qualify such repair.

Texas Research Institute Austin, Inc. (TRI/Austin) will determine the capabilities and limitations of various NDE methods for detecting defects in FRP bonded repairs of concrete infrastructure. TRI/Austin operates the Nondestructive Testing Information Analysis Center (NTIAC) for the U.S. Department of Defense. The in-house capabilities gained by running NTIAC make us uniquely qualified to achieve the proposed effort.

In Phase 1, TRI/Austin will perform a complete information collection and critical review to determine which NDE methods offer the most promise for detecting defects in FRP repairs. This review will recommend the four most promising NDE techniques, and vendors qualified to complete them. Samples containing artificially introduced defects, such as delaminations, debonds, voids, and resin rich areas will be sent to these four vendors for laboratory inspections. All data collected throughout the project will be analyzed and reported to NIST.

Phase 2 work will include field development of the most promising technique(s), as well as developing inspection procedures and calibrations standards.

COMMERCIAL APPLICATIONS:

Composite materials are becoming more and more common. They are being used in such applications as aeronautics, automobiles, and boats. The technology used in this project will be able to evaluate such items as composite masts and fiberglass panels.

FY 99 Phase 1 Award Winner

TOPIC:	8.17	Microelectronics Manufacturing Infrastructure
SUBTOPIC:	8.17.1T	Scanning Microwave Microscope for 2-D and 3-D Dopant Profiling of Semiconductors
TITLE:		Nanometer-Scale Semiconductor Analysis with Tunable Microwave Microscopy and Spectroscopy
FIRM:		Atolytics, Inc. 545 Orlando Avenue State College, PA 16803-3479
PRINCIPAL INVESTIGATOR:		Gregory McCarty 814-863-8220
AWARD AMOUNT:		$75,000

ABSTRACT:

We propose to develop tunable microwave frequency scanning tunneling microscopy and spectroscopy for 2-D and 3-D dopant profiling of semiconductors. For Phase 1, we will use existing state-of-the-art instrumentation at Penn State. We will have access to a wide range of semiconductor samples which will undergo complementary analyses using the current standard technologies. We will be partnering with a leading analytical services company for this purpose. Our tunable microwave frequency scanning tunneling microscopes are extremely versatile in terms of measuring linear and nonlinear, scalar and vector, and transmitted and reflected signals over a wide range of biases and frequencies (0-20 GHz). In Phase 1, we will measure tunneling impedance as a function of frequency and bias. We will determine which measurements are information-rich in terms of dopant profiling. In subsequent work, we will make these measurements quantitative. Through partnerships, we have ready access to samples, markets, and future technologies as they are being developed.

COMMERCIAL APPLICATIONS:

Nanometer-scale analyses for the electronics, communications, and biotechnology industries. The commercial applications of this work will be developed simultaneously through ongoing partnerships.

FY 99 Phase 1 Award Winner

TOPIC: 8.17 Microelectronics Manufacturing Infrastructure

SUBTOPIC: 8.17.5T Advanced Chemical Modeling and Simulation Tools for Semiconductor Processing

TITLE: Advanced Chemical Modeling and Simulation Tools

FIRM: Reaction Design
11436 Sorrento Valley Road
San Diego, CA 92121

PRINCIPAL INVESTIGATOR: Erik Egan
619-550-1920

AWARD AMOUNT: $74,391

ABSTRACT:

Chemistry is at the heart of most semiconductor and materials manufacturing processes. Models that describe the interaction between chemistry and transport in reactors are a core technology for improving production efficiency, quality control and operating costs. A key input to these models is a reaction mechanism and associated chemical data. Today, synthesis of these mechanisms is a difficult, time-consuming task and there are few support tools. This proposal presents a plan for development of a prototype environment that incorporates: chemical databases, uncertainty analyses, chemically reacting flow simulation, visualization and data analysis. The goal is to develop a commercially viable system that will reduce the time needed to generate chemical mechanisms and analyze the results of reacting flow simulations. Five tasks are proposed: (1) review methods for generating mechanisms; (2) design a software architecture and database management system for storing chemical species, their chemical properties, reaction steps, mechanisms, uncertainties and documentation; (3) implement a prototype system (based on the NIST CKmech code) that simplifies access to the information base; (4) integrating into CHEMKIN reaction modeling environment algorithms for sensitivity and uncertainty analysis; and (5) define a post-processing analysis system.

COMMERCIAL APPLICATIONS:

One of the largest challenges in the semiconductor industry today is the move to larger wafers and smaller features while also introducing new material systems. Chipmakers will reduce resulting process development costs by using simulation tools from this research to gain more information with fewer experimental wafers, while freeing production capacity for processing saleable material. They will also speed process optimization by replacing time consuming experiments with faster simulations to reach high-yielding processes quickly, shortening time-to-market. Their equipment and chemicals suppliers will likewise use the software for faster, cheaper reactor and chemical systems development to accelerate overall technology evolution. The entire industry will apply the product to understand how to improve efficiency and reduce emissions of harmful waste chemicals. Such uses readily extend to combustion and chemical processing industries.

FY 99 Phase 1 Award Winner

TOPIC:	8.17	Microelectronics Manufacturing Infrastructure
SUBTOPIC:	8.17.7T	High Temperature Thin Film Insulation
TITLE:		Novel High Temperature Insulators for Thin Film Thermocouples
FIRM:		ATMI, Inc. 7 Commerce Drive Danbury, CT 06810
PRINCIPAL INVESTIGATOR:		Frank DiMeo, Jr. 203-794-1100
AWARD AMOUNT:		$75,000

ABSTRACT:

Thin film thermocouple technology for real-time, high-temperature (- 1000°C), distributed thermometry spans a wide range of commercial application areas, including semiconductor manufacturing and combustion engine feedback. At present, a lack of suitable high-temperature thin film insulators, required to provide an adhesive interface we well as an electrical and chemical barrier between the substrate and the thermo-elements, severely hinders widespread implementation of this technology. Compounds from the MgO-SiO2-Al203 ternary system offer the opportunity to overcome the limitations of conventional insulators. These compounds are chemically compatible with silicon, have high resistivity at elevated temperatures, and offer a range of coefficients of thermal expansion. Metal organic chemical vapor deposition (MOCVD) of complex oxides is an attractive fabrication method because of its ability to cover large areas with high quality films and, coupled with the ability to coat complex shapes, can conformally encapsulate thin film thermocouples for improved robustness. In Phase 1, MgO and MgAl204 films will be deposited by MOCVD on silicon substrates and fully characterized, including electrical behavior at elevated temperatures. In Phase 2, film performance will be optimized, full encapsulation of thin film thermocouples will be examined, and the deposition process will be extended to insulator films such as Mg2Al3(AISi)5018.

COMMERCIAL APPLICATIONS:

The potential commercial applications of thin film insulator compounds from the MgO-Si02-Al203 ternary system include high temperature insulators for silicon wafer based thermometry using thin film thermocouples, gas turbine engine thermometry, and barriers/buffer layers for advanced semiconductor devices.

FY 99 Phase 1 Award Winner

TOPIC: 8.17 Microelectronics Manufacturing Infrastructure

SUBTOPIC: 8.17.8T Measurement of Trace Alpha Radiation in Polymeric Microchip Material

TITLE: Measurement of Trace Alpha Radiation In Polymeric Microchip Material

FIRM: Fayette Environmental Services, Inc.
120 E. Davis Street, P.O. Box 21
Fayette, MO 65248-0021

PRINCIPAL INVESTIGATOR: Rhys N. Thomas
660-248-1911

AWARD AMOUNT: $75,000

ABSTRACT:

The reduction of alpha particle emission induced soft error upset has been identified in the industry association's National Technology Roadmap for Semiconductors as a major concern. However, the measurement of ultratrace alpha radiation levels is difficult, and has become a source of conflict between materials suppliers and microchip manufacturers. Development of an inexpensive standardized test method has been solicited to allow for accurate analysis to a detection limit far below the current low-alpha standards. Not only will this alleviate the misunderstandings between suppliers and users, but also will permit further research into the source and removal of the ultratrace contamination.

The process to be developed under this proposal utilizes three unique principles in order to provide an improvement in detection limit of more than a factor of 50 over the best available technology. First, this process evaluates volumetric content of alpha activity rather than surface content, greatly increasing the effective size of the sample. Second, it requires no chemical separations or processes to isolate trace alpha emitters from the encapsulant material. Third, it utilizes a unique, digital counting system that provides precise selectivity for alpha decay events, thus eliminating background radiation and improving alpha detection sensitivity.

COMMERCIAL APPLICATIONS:

The method for ultratrace detection of alpha emissions developed under this proposal will be of value not only to the semiconductor industry but also for environmental monitoring at various governmental sites formerly used for nuclear weapons research or uranium production. The proposed device will be economical enough to allow surveying of contamination fields to map plume development.

FY 99 Phase 1 Award Winner

TOPIC: 8.17 Microelectronics Manufacturing Infrastructure

SUBTOPIC: 8.17.9T Advanced Ion Beam Methods for Nanotechnology

TITLE: Highly Charged Ions - A New Tool for Nanotechnology

FIRM: Charles Evans & Associates
301 Chesapeake Drive
Redwood City, CA 94063

PRINCIPAL INVESTIGATOR: Kuang Jen Wu
650-369-4567

AWARD AMOUNT: $74,974

ABSTRACT:

The goal of this proposal is to develop advanced mass spectrometry instrumentation based on the use of slow, highly charged ion (HCI) such as Xe44+ or Au69+. The competitive characteristics of this excitation source for secondary ion mass spectrometry (SIMS) arises from the unique power density of ~1E14 W/cm2 that can be delivered into a nanometer-scale surface area. Secondary ion yields in highly charged ion SIMS are increased by a factor of 100 - 1000 as compared to conventional SIMS. This improvement enables chemical structure analysis on a 10 nm length scale through integration of coincidence counting. The proposed research will determine the feasibility of Highly Charged Ion SIMS for industrial applications in the semiconductor and biotech industries. We propose to target (1) advanced metallization: sub-micron copper lines on silicon; and (2) biomolecular assemblies: interface bonding properties as examples where available techniques have been insufficient in addressing critical industry needs. Phase 1 research will be performed at Lawrence Livermore National Laboratory where highly charged ion technology has been developed for about a decade.

COMMERCIAL APPLICATIONS:

Analytical instrumentation for chemical analysis of nanometer scale surface features.

FY 99 Phase 1 Award Winner

TOPIC:	8.17	Microelectronics Manufacturing Infrastructure
SUBTOPIC:	8.17.10T	High Precision Manufacturing of Rockwell Diamond Indenters
TITLE:		Innovative Manufacturing Methods for Diamond Indenters
FIRM:		Gilmore Diamond Tools, Inc. 43 Roger Williams Avenue East Providence, RI 02916
PRINCIPAL INVESTIGATOR:		Michael Mihalec 401-438-0717
AWARD AMOUNT:		$75,000

ABSTRACT:

Due to the inherent properties of Natural Diamond, indenters produced by traditional manufacturing methods yield unacceptable variations in their geometric profiles. It will become our objective to repeatedly reproduce Rockwell indenters with tighter geometric tolerances than those currently available for standardization and traceability. Our primary focus will be the implementation of advanced grinding systems, coupled with experimental techniques and variations in grinding wheel specifications. The variables will translate directly into documented test results directed towards minimal variations in cone angle and radius measurements. Additional areas of evaluation will monitor surface finish, and interpret measurement results gathered both on site and though working relationships with Government Facilities and Universities.

COMMERCIAL APPLICATIONS:

Diamond indenters produced utilizing advancements in manufacturing technologies would represent an available source of calibration grade indenters with direct traceability to NIST and ISO standards. These indenters would be available to testing laboratories, Test Block manufacturers, Hardness Testing Machine manufacturers, and facilities dependent upon accurate and repeatable hardness testing results, with direct traceability to National Standards.

FY 99 Phase 1 Award Winner

TOPIC:	8.18	Microfabrication and Micromachining
SUBTOPIC:	8.18.1T	Ultra-Sensitive Atomic Force Microscope Cantilevers
TITLE:		Ultra-Sensitive Torsional Oscillators for Scanning Probe Microscopes
FIRM:		Xidex Corporation 8906 Wall Street, Suite 105 Austin, TX 78754
PRINCIPAL INVESTIGATOR:		Validmir Mancevski 512-339-0608
AWARD AMOUNT:		$75,000

ABSTRACT:

Xidex proposes to team with UT Austin to develop a new type of ultra sensitive force sensor suitable for use with scanning probe microscopes. Ultra sensitive force detection will be enabled by using high-*Q* silicon multiple torsinal oscillators. Our strategy to attain and surpass a force sensitivity of 10^{-16} N/Hz$^{1/2}$, which is required to measure extremely small electro-dynamic forces, involves two main thrusts: (1) utilizing double- and multiple-torsional oscillator modes, which can enhance oscillator quality factor *Q* by a factor of 100 or more; and (2) replacing ultrathin silicon-nitride (amorphous) cantilevers with single-crystal silicon structures, which can further enhance the *Q* by a similar or greater factor. Phase 2 will focus on improving the repeatability and scalability of the batch fabrication process, thus enabling incorporation of ultra-sensitive cantilevers into planed OEM modules and sale of cantilevers themselves to end users of scanned probe microscopy tools and instruments.

COMMERCIAL APPLICATIONS:

Targeted commercial applications include magnetic force microscopy (MFM), magnetic force resonance microscopy (MFRM), lateral force microscopy (LFM), and scanning potentiometry. Two commercial embodiments of the technology will be evaluated: (1) sensing components, bundled with appropriate software, for sale to OEMs of laboratory instrumentation; and (2) integration of the technology into our own stand-alone tools for sale directly to end users. The channel we pick will depend on the application or applications that have the greatest commercial potential.

FY 99 Phase 1 Award Winner

TOPIC:	8.18	Microfabrication and Micromachining
SUBTOPIC:	8.18.5T	Three-Dimensional Imaging System for Low Activity Brachytherapy Sources
TITLE:		High Resolution, 3-D, Digital Image Calibration System for Brachytherapy Sources
FIRM:		Industrial Quality Inc. 640 E. Diamond Avenue, Suite C Gaithersburg, MD 20877-5323
PRINCIPAL INVESTIGATOR:		Harold Berger 301-948-2460
AWARD AMOUNT:		$75,000

ABSTRACT:

Improved methods are needed to calibrate the radiation emission uniformity of small radioactive sources used for radiation therapy. Improvements are needed in terms of spatial resolution and ease of use. A novel radiation imaging instrument is proposed to be developed for use in mapping the three-dimensional radiation levels emitted from relatively low activity brachytherapy sources. A scintillating glass-CCD camera system offers the potential for sensitive, high resolution imaging in a geometry what will provide a full three-dimensional map of the emitted radiation, in a measurement time estimated in minutes. The developed instrument will permit measurements to be made in an efficient manner, in an operational mode much simpler to use as compared to the cumbersome methods currently in use. The Phase 1 project is planned to demonstrate the feasibility of the imaging system and geometry and help determine if additional scintillators will be needed for the prototype instrument. The proposed radiation camera system clearly has the sensitivity needed for measurements/calibration of low activity sources. A major advantage of the proposed scintillator-camera system is the prospect for rapid, easy-to-use measurements that can be related to dose.

COMMERCIAL APPLICATIONS:

Multiple markets are foreseen for this efficient, radiation mapping scintillator-camera instrument. Instrument needs exist with manufacturers of small radioactive sources, with organizations that offer radiation calibration services and, particularly with the many radiation oncology centers that are the primary uses of brachytherapy sources. There are more than 1,500 radiation oncology facilities in the U.S. alone, representing a potential market of $75 million.

FY 99 Phase 1 Award Winner

TOPIC: 8.20 Photonics Manufacturing

SUBTOPIC: 8.20.1T Photonic Components/Systems Manufacturing Cost Reduction

TITLE: Materials Processing for Mass-Producible Distributed Photonic Amplifiers

FIRM: Intelligent Fiber Optics Systems (IFOS)
1778 Fordham Way
Mountain View, CA 94040

PRINCIPAL INVESTIGATOR: Richard Black
650-967-4107

AWARD AMOUNT: $75,000

ABSTRACT:

Photonic systems offer enormous potential because of the extraordinary large bandwidth that they deliver. However, component cost dominated by optical amplifiers constrains their proliferation. Furthermore, a common problem is component loss including splitting-loss whereby signal strength per channel is reduced whenever a signal is split. For an economic and compact solution to this problem, there is the need for integrated-optic devices that combine splitting and amplification of light. Erbium-doped amplifiers have become well established in fiber form. However, their manufacture is today complex and costly. IFOS proposes to combine integrated-optic splitter fabrication with a new approach for manufacture of integrated-optic amplifiers. It will open up new application opportunities for amplifiers in subsystems intended for sensing, signal processing and communications. Our approach brings together processing technologies that are low-cost, low-temperature and lend themselves to high-volume production. In Phase 1, we will focus on materials processing and analyze, fabricate and characterize active-glass waveguide substrates for proof-of-concept demonstration of high gain-per-unit-length. In Phase 2, we will demonstrate active-ridge-waveguides and fabricate an optimized 1x2 lossless splitter and begin commercialization activities. IFOS has demonstrated its expertise in photonics including amplifiers and couplers/splitters, materials processing, business and marketing.

COMMERCIAL APPLICATIONS:

The IFOS low-cost, highly manufacturable, distributed photonic amplifier technology will significantly enhance performance of photonic systems in telecommunications, cable TV, Internet access and optical signal processing systems. A multiplicity of distributed, low-cost, low-gain amplifiers and splitters can be integrated on the same chip to perform cost-effective all-optical signal processing with improved signal-to-noise ratios. The fiber amplifier market is now over $500 million and is doubling every four years.

FY 99 Phase 1 Award Winner

TOPIC:	8.20	Photonics Manufacturing
SUBTOPIC:	8.20.4T	In Situ, Noncontact Temperature Measurements of Semiconductors
TITLE:		Noncontact Measurement of MBE Substrate Temperature
FIRM:		ARACOR 425 Lakeside Drive Sunnyvale, CA 94086
PRINCIPAL INVESTIGATOR:		Jonathan Kerner 408-733-7780
AWARD AMOUNT:		$75,000

ABSTRACT:

There is a need to improve the reliability of semiconductor photonic devices, such as lasers, LEDs, photodetectors and modulators which are critical to the high-growth industries concerned with wireless and optical telecommunications, high speed networks, and imaging. The lack of accurate, *in situ* process control monitors during device fabrication can lead to defect generation and poor reproducibility of component parameters, such as film thickness and composition, which strongly impact device lifetime and performance.

To improve reliability, new deposition processes are being developed at low temperatures (150° to 450°C) using molecular beam epitaxy (MBE). This Phase 1 project is designed to demonstrate the feasibility of using x-ray diffraction for the *in situ*, not-contact measurement of substrate temperature, a critical MBE processing parameter. The objectives will be to show that the x-ray measurement can yield a temperature accuracy of ±1°C in the presence of substrate rotation, and to evaluate the effect of epitaxial films on the measurement. A breadboard instrument will be built to test the concept with GaAs substrates, and a collaboration with NIST to examine relevant samples and interfacing issues will insure a Phase 2 prototype which is compatible with the MBE processing chambers.

COMMERCIAL APPLICATIONS:

The main commercial applications are associated with epitaxial and thin film growth equipment processes including molecular beam epitaxy (MBE), rapid thermal processing (RTP) and chemical vapor deposition (CVD).

FY 99 Phase 1 Award Winner

TOPIC:	8.20	Photonics Manufacturing
SUBTOPIC:	8.20.6T	Ultra-Hard/Sapphire Tools for Precision Machining
TITLE:		Ultra-Hard Nanoceramic Tools for Precision Machining
FIRM:		Nanopac Technologies, Inc. 35 Hutchinson Road Allentown, NJ 08501
PRINCIPAL INVESTIGATOR:		Dr. Shih Chieh Liao 732-445-5627
AWARD AMOUNT:		$70,000

ABSTRACT:

This Phase 1 project will result in wear-resistant nanoceramic cutting tools for use in ultraprecision machining operations. In previous research, we have discovered a method for producing fully dense, bulk ceramic materials which retain their nanoscale grain size. Characterization of these materials has demonstrated that the nanoceramics have exceptional wear resistance with an extremely fine surface finish. As an example, we have been able to produce nanograined ceramics with wear resistance that is 4x better than their micrograined counterpart. In this effort, we will apply our processing technique to produce bulk ceramic materials with grain sizes <100nm, densities >99%, and surfaces finishes below 50nm. We will then characterize these materials for their usefulness as ceramic cutting tools. We anticipate that the combination of ultrafine grain size and nearly full density will impart the required properties to this new generation of materials. In the Phase 2 effort, we will work with our partner, Tempo Technology Corp., to optimize the scale-up to produce large bulk samples and then to optimize the properties of the cutting tools for the best combination of wear resistance and toughness. The Phase 3 effort will address the manufacture and commercialization of specific nanoceramic cutting tools.

COMMERCIAL APPLICATIONS:

The nanoceramic cutting tools developed in this project are expected to replace diamonds in a variety of applications. In those cases where diamond interacts with the workpiece, we expect that the ceramic materials will exhibit better stability and lower reactivity. In addition, the nanoceramics are expected to exhibit many properties similar to diamond, such as cutting tool sharpness and wear resistance. Until now, there has been no suitable alternative to diamond for ultraprecision cutting operations. However, we expect that the nanoceramics will match many properties of diamond, and may actually exceed it in terms of toughness due to the retained nanograin size.

FY 99 Phase 1 Award Winner

TOPIC:	8.22	Integration of Manufacturing Applications
SUBTOPIC:	8.22.1T	Next Generation Process Exchange Tools and Applications
TITLE:		Integration of Manufacturing Applications Through Next Generation Process Exchange Technology
FIRM:		Intelligent Systems Technology, Inc. 2800 28th Street, Suite 306 Santa Monica, CA 90405
PRINCIPAL INVESTIGATOR:		Azad Madni 310-581-5440
AWARD AMOUNT:		$74,955

ABSTRACT:

The overall objective of this SBIR effort is to provide an easy-to-use generic PSL representation viewer and editor and a PSL Translator toolkit to facilitate development of translators. In addition, this project will also evaluate the adequacy of the organizational aspect of the current PSL ontology. A robust and complete common process representation is essential for application integration in a manufacturing environment. The PSL is positioned to fulfill that requirement. PSL is not used in any commercial product because of lack of good generic PSL tools. To this end, the proposed effort is directed to create a generic PSL representation viewer and editor for the users to review and modify process models stored in PSL format. The proposed effort will also create a PSL Translator architecture and toolkit that will speed up the development of translators for integrating various applications using PSL as the common language. The proposed scalable, web-based PSL Viewer and Editor architecture and the proposed symmetric modular design for the PSL Translator will make PSL easier to use and greatly reduce the effort in manufacturing application integration.

COMMERCIAL APPLICATIONS:

Commercial applications of this research include: (a) process exchange between different applications such as process design, workflow managers, project management tools, schedulers and process simulations; (b) supply chain integration and management; (c) enterprise resource planning; and (d) enterprise application integration.

FY 99 Phase 2 Award Winner

TOPIC:	8.1	Atmospheric Sciences
SUBTOPIC:	8.1.4.A	Automated Airborne Measurement of Atmospheric Chemical Species
TITLE:		Automated Airborne Measurement of Ozone
FIRM:		ADA Technologies, Inc. 304 Inverness Way, S. Suite 365 Englewood, Colorado 80112
PRINCIPLE INVESTIGATOR:		Patrick D. French 303-792-5615
AWARD AMOUNT:		$299,987

ABSTRACT:

Ozone is arguably the most important trace gas in the atmosphere, and improved monitoring of ozone throughout the atmosphere is essential. This Phase 2 project continues the development of a complete, automated system for measuring ozone from on board commercial aircraft. There is already one program within NOAA, CAAMP (Commercial Aircraft Atmospheric Measurement Program), for measuring a variety of trace gases in this manner. Since the logistics and cost to install commercially available ozone instruments and data recorders on a large number of commercial aircraft would be prohibitive, it is imperative to develop a compact, self-contained system specifically designed for these measurements.

The ozone analyzer is based on a compact UV-absorption design originated at the University of Colorado for use on meteorological balloons. In Phase 1, this design was modified for use in a pressurized aircraft, and ADA-designed electronics were added. In Phase 2, the design will be refined, including packaging for mounting in standard avionics racks and adding interfaces to communicate with aircraft systems. The Phase 2 instrument will receive various parameters (location, altitude, time) from data bus, as well as communicate ozone data onto the data bus, enabling a variety of data recording or real-time reporting options.

COMMERCIAL APPLICATIONS

The initial application for this instrument would be in the NOAA program for measuring atmospheric ozone. A potentially much larger market would be in the expendable sonde market. Hundreds of balloon-borne ozone sondes are launched every year, and this instrument should have a cost comparable to that of the electrochemical sondes, while offering improved accuracy and ease of use. A second area of interest would be in photocopy centers where photocopies can provide significant amounts of ozone. This instrument could be used to monitor these ozone levels and provide warnings if unsafe levels exist.

FY 99 Phase 2 Award Winner

TOPIC:	8.2	Ocean Observation Systems
SUBTOPIC:	8.2.1A	Operational Ocean Instrumentation, Measurement and Data
TITLE:		Horizontal ADCP for Remote Mapping of Currents
FIRM:		RD Instruments 9855 Businesspark Avenue San Diego, CA 92131
PRINCIPLE INVESTIGATOR:		Steve Bradley 619-693-1178
AWARD AMOUNT:		$300,000

ABSTRACT:

The objective is to develop a horizontal ADCP (HADCP) for mapping horizontal flow structure in channels, harbors, and ports. This would be useful in areas where currents pose a threat to safe boat navigation. The Challenge for such a system is to measure flow even though bottom and surface returns could contaminate the profiles. Phase 2 will develop a long range HADCP using a frequency of approximately 150kHz. The HADCP must possess three critical features. First of all, the unit should be modestly priced. In situations where a single unit is sufficient, only one need be purchased. In more difficult regions, multiple units will still be very competitive with other higher cost technologies(such as the phased array sonar developed by Japan). Secondly, the unit must have low side lobes. Thirdly, it is vital to implement the signal processing algorithms developed during Phase 1 into the firmware of the sonar to enable real-time data quality assessment.

COMMERCIAL APPLICATIONS

The first market for such a system is flow monitoring in rivers. Ports and harbors represent a slower-to-develop market, but one which should be at least as large in the long term. There is already a sizable market for crossed-path travel-time acoustic systems in rivers. A Horizontal ADCP has the potential to improve river flow monitoring, to make it less expensive and to open new sites to measurement. If horizontal ADCPs are successful in rivers, the same hardware could be used in the more difficult stratified channels. Hence, development of the river market will facilitate development of the port and harbor market.

FY 99 Phase 2 Award Winner

TOPIC:	8.3	Living Marine Resources
SUBTOPIC:	8.3.1A	Rapid, Sensitive, Non-Lethal Method for the Identification of Bacterial Pathogens of Salmonids
TITLE:		Double Capture Amplification System for Bacterial Pathogen Detection in Fish
FIRM:		ProED, Inc. 9290 Gaither Road Gaithersburg, MD 20877
PRINCIPLE INVESTIGATOR:		Shang Ding Zhang 301-527-1558
AWARD AMOUNT:		$300,000

ABSTRACT:

Bacterial pathogens in salmonids, such as *Renibacterium salmoninarum* and *Aeromonas salmonicida*, are difficult to identify by conventional diagnosis due to their extremely slow growth and the absence of an efficient selective medium. Diseases caused by these pathogens represent a serious problem both in the fishing industry and for conservation efforts. While several PCR-based assays appear to be useful, they are generally complex laboratory procedures and not suitable for large scale screening. We have proposed to develop a novel screening method, the “Double Capture Amplification System” (DCAS), to detect *R. salmoninarum* in salmonids. This procedure combines several powerful molecular biology tools in an innovative manner to develop a rapid, non-lethal, highly sensitive assay kit. Our Phase 1 research has demonstrated the feasibility of the proposed assay and initiated development of the prototype diagnostic kit. The major goals for the second phase of this project are to adapt, and optimize the assay for the detection of *Renibacterium salmoninarum* in various tissues in fish, determine the sensitivity and specificity of the assay, and begin production and quality control testing of the survey kits. In addition, we will initiate studies for the adaptation of DCAS to other organisms such as *Aeromonas salmonicida*.

COMMERCIAL APPLICATIONS

The goal of this research is to develop a series of non-lethal assays to rapidly detect bacterial pathogens in salmonids and other fish. For long range commercial applications, however, this technology could be easily expanded to target any pathogen whose RNA sequence is at least partially characterized, including non-bacterial pathogens such as *Pfiesteria piscicida*. The major markets would include freshwater hatcheries and sea farms, conservationists, and wildlife management groups for fish health monitoring and pathogen identification in suspected fish.

FY 99 Phase 2 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.2SG Aquaculture: Water Reuse and Effluent Treatment Systems

TITLE: Operation & Evaluation of a Commercial Pilot Indoor Water Reuse Marine Shrimp Production System

FIRM: Seafood Systems, Inc.
3450 Meridian Road
Okemos, MI 48864

PRINCIPLE INVESTIGATOR: Russell A. Allen
517-347-5537

AWARD AMOUNT: $150,000

ABSTRACT:

Shrimp imports to the U.S. are by far the single biggest contributor to the seafood portion of the U.S. balance of trade deficit. Seafood Systems, Inc. proposes to operate and evaluate its indoor marine shrimp production system designed to prove that commercial quantities of marine shrimp can be produced at competitive costs with shrimp produced from outdoor pond shrimp production systems. The system design embraces : 1) commercial viable capital and operating costs; 2) production facility located away from environmentally sensitive coastal areas; 3) reduction or elimination of aquatic effluents; 4) bio-security; 5) year-round shrimp production; and 6) production of high quality, fresh shrimp for the U.S. market. Phase 1 research evaluated the prototype indoor production system. The trial indicated that the water reuse system can be commercially viable. Phase 2 research will evaluate the operation of a commercial pilot marine shrimp production system.

COMMERCIAL APPLICATIONS

Shrimp imports continue to increase to the U.S. at the same time the domestic shrimp farming industry is shrinking. The success of Phase 2 of this project will help to reverse that trend and put the U.S. on the path to successful commercial production of large quantities of fresh marine shrimp for the U.S. market on a year round basis. The new industry will provide mew employment opportunities and will lead to the reduction of U.S. shrimp imports.

FY 99 Phase 2 Award Winner

TOPIC: 8.4 Ocean Science

SUBTOPIC: 8.4.5 SG Sensor Technologies for Measuring Microbiota

TITLE: Micro-Radiometer/Flourometer for Ocean Sensing

FIRM: Optomechanical Enterprises, Inc.
7 Waterbury Court
Allentown, NJ 08501

PRINCIPLE INVESTIGATOR: Arthur T. Poulos
609-758-8898

AWARD AMOUNT: $152,286

ABSTRACT:

This SBIR project will research and develop a new class of miniature hyperspectral optical instruments for aquatic monitoring. The approach uses a molded spectrograph of exceedingly small size as the key optical component. This so-called micro-spectrograph can be implemented into a variety of miniature instrument configurations, e.g., as a radiometer, reflectometer, flourometer, and spectophotometer. These micro-instruments will be capable of measuring a variety of in-water and at-surface optical quantities of interest to the ocean science and aquaculture communities, such as irradiance reflectance, underwater spectral irradiance, vertical attenuation coefficients, chlorophyll concentration, dissolved organic matter, and speciation of phytoplankton.

Phase 2 of the project will develop and test two prototype aquatic sensors: a micro-radiometer and a micro-flourometer. Specific tasks will include: optimization of the optical designs, miniaturization of the data acquisition electronics, integration of opto-mechanical and electro-optical components, laboratory testing, field testing, and final design modification. The final deliverables of Phase 2 will be working prototypes and detailed design drawings which are suitable for transition to a Phase 3 commercialization effort.

COMMERCIAL APPLICATIONS

One water-based application is real-time oceanographic sensing on docks and in moorings, buoys, and roving autonomous vehicles. Another is aquaculture monitoring of noxious cyanobacteria and algal blooms, e.g., in catfish farming and municipal and county water quality management. Spin-off applications include industrial process control sensors, graphics colorimetry, dental color matching, and hand-held substance monitors.

FY 99 Phase 2 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.6SG	Bioremediation/Decontamination Technology for Contaminated Sediments
TITLE:		Development of a Shipboard Ultrasonic Ballast Water Organism Control System
FIRM:		Oceanit Laboratories, Inc. 1100 Alakea Street, 31st Floor Honolulu, HI 96813
PRINCIPLE INVESTIGATOR:		Robert Bourke 808-531-3017
AWARD AMOUNT:		$150,000

ABSTRACT:

This project develops and demonstrates an innovative and economic technology that uses ultrasonic energy to destroy organisms in a ship ballast system, thereby minimizing impact from alien species introduced from shipping. Phase 1 results successfully showed that organisms were rapidly destroyed by ultrasound at various frequencies and power densities. Although the mechanism of destruction in an ultrasonic bath is typically believed to be cavitation, results indicate that extremely high acceleration forces experienced by small particles in an ultrasound field create the primary mechanism of damage. Forces (on the order of 1000's of G's) cause individual organisms, or parts of an organism, to vibrate in resonance with sonic field, literally ripping the organisms apart. Phase 2 efforts will build on Phase 1 successes to design and build a full-scale prototype Shipboard Ultrasonic Ballast Water Organism Control (SUBWOC) system, which will include a ten-foot long section of pipe sheathed in piezo-ceramic ring sound transducers. Tasks include design and fabrication of the SUBWOC, bench testing and lab testing with 300-gallons of known organism cultures. Thereafter, sea trials will occur aboard commercial vessels by our Industry Partners, including Mason Navigation Company and Sause Brother's Tug & Barge.

COMMERCIAL APPLICATIONS

Successful demonstration of the SUBWOC would lead directly to production models that would be available for sale to commercial merchant and military vessels across the nation and throughout the world. With minimal alteration, SUBWOC could also serve to eliminate colonizing organisms from cooling water intake systems that service land-based electrical generators and industrial processing.

FY 99 Phase 2 Award Winner

TOPIC:	8.4	Ocean Science
SUBTOPIC:	8.4.7A	A Microbial Sampler for Deep-sea Research and Discovery
TITLE:		Device for the Uncontaminated Collection of Multiple Microbial Samples from Hydrothermal Vents and Other Aquatic Environments
FIRM:		McLane Research Laboratories Falmouth Technology Park 121 Bernard E.St.Jean Drive East Falmouth, MA 02536
PRINCIPLE INVESTIGATOR:		John Billings 508-495-4000
AWARD AMOUNT:		$285,796

ABSTRACT:

The objective of this research project is the development of an Autonomous Microbial Sampler (AMS) that will obtain uncontaminated and exogenous DNA-free microbial samples from deep-sea hydrothermal vents and other aquatic ecosystems. Sampling with the AMS may be conducted using manned submersibles, Remotely Operated Vehicles (ROV), Autonomous Underwater Vehicles (AUV) or during hydrocast operations on ships. The modular device consists of a titanium sample nozzle for sampling potentially hot samples (- 250 C) and fluid handling components housed within a stainless steel frame for collection of six independent filtered or unfiltered samples. An on board microcomputer permits sampling to be controlled by the investigator, external devices (e.g. AUV computer) or internal programming. Temperature, volume pumped and other parameters are recorded during sampling. Detailed engineering design of the device and choice of construction of a prototype AMS, and a program of thorough laboratory and field testing of it's operation. Minor design changes based on testing results will be incorporated into the device. Field testing will be conducted during an upcoming R/V Atlantis/DSV Alvin cruise to a deep water hydrothermal vent site off the U.S. or Mexican West coast in spring 2000. Test hydrocast water column sampling will be conducted during an R/V Endeavor cruise to the Sargasso Sea in spring 2001.

COMMERCIAL APPLICATIONS:

Study of ecology and diversity of microbes in remote or extreme environments, whether it be for basic research interests or commercial applications such as a search for new sources of pharmaceuticals, require the ability to acquire uncontaminated samples that is compatible with both techniques of microbial culture and DNA sequencing. The AMS constitutes new technology that will permit such samples to be taken. The initial market will be the basic research microbiology and oceanography community and will expand into components of the industrial sector including pharmaceutical laboratories.

FY 99 Phase 2 Award Winner

TOPIC: 8.7 Advanced Technology Program

SUBTOPIC: 8.7.1T Technologies for Large Area Electronic Materials and Devices

TITLE: 3-D Printing of Opto-Electronic Components on Flexible Substrates

FIRM: Gemfire Corporation
2471 East Bayshore Road Suite 600
Palo Alto, CA 94303

PRINCIPAL INVESTIGATOR: Nigel Cockroft
650-849-6800

AWARD AMOUNT: $300,000

ABSTRACT:

The technique of screen printing has been demonstrated to be of practical benefit in numerous engineering applications. Over the past two decades, these benefits have been widely recognized by the electronics industry, as evidenced by the flourishing fields of screen-printed thick-film electronics. Multilayer circuits are now manufactured by the sequential deposition of conductive and resistive paste patterns and the deposition of solder bumps and epoxies to secure precisely mounted components. We propose to apply these advanced screen printing methods to large-area opto-electronic applications. In Phase 1, we demonstrated the feasibility of screen printing three-dimensional optical components on a flexible substrate using electroformed stencils, where feasibility was defined as being able to print fine-pitch 3-D optical features of precise dimension, and being able to print a second set of features over the first without damaging either. In Phase 2, we will develop several precision printing techniques required to demonstrate a multilayer device on a flexible polymer substrate for consumer-electronics display applications.

COMMERCIAL APPLICATIONS:

The ability to screen printing 3-D opto-electronic components on thin, flexible substrates will provide a powerful new way of manufacturing low-cost, large-area integrated optics. Used in conjunction with existing electronic printing capabilities, the proposed method will greatly accelerate the emergence of large-area opto-electronic devices. The technology is anticipated to enable numerous unexpected applications in thin-film electronics.

FY 99 Phase 2 Award Winner

TOPIC: 8.9 Manufacturing Engineering

SUBTOPIC: 8.9.7T Next Generation Process Exchange Tools and Applications

TITLE: A Framework for Building Information Translators

FIRM: Knowledge Based Systems, Inc.
1408 University Drive East
College Station, TX 77840

PRINCIPAL INVESTIGATOR: Florence Tissot
409-260-5274

AWARD AMOUNT: $299,760

ABSTRACT:

Today's manufacturing companies are concentrating their energy towards breaking the barriers between firms all along the supply chain to create a virtual enterprise whose goal is to operate as if the chain was a single entity. Breaking these barriers involves facilitating collaboration and communication at all levels of the enterprise. A key roadblock to this sort of facilitation is the need for a computer system interoperability that enables manufacturers and product suppliers to move and share information up and down the supply chain.

In this project, we propose to implement a framework for developing and maintaining an information translator for the entire supply chain. The translators generated by the framework will not only enable the exchange of properly formatted data, but will take into account the meaning of data during the translation. The key innovations of this project are: (1) the use of ontologies to enable information translation, (2) foundations for ontology harmonization, (3) semantic translation through inferences, and (4) automated generation and management of translators. The technology developed in this project will enable companies to cost- and time-effectively integrate their ERP and ERM systems with their suppliers' stand-alone software applications.

COMMERCIAL APPLICATIONS:

There is strong evidence for commercial application potential for the proposed technology in several different areas. The most promising area is the ERP application area that is lacking tools that facilitate rapid integration of ERP systems with other stand-alone software tools. The explosive growth in ERP systems is expected to continue for the next few years with a continued technology void for integration tools. The second and broader market segment is to facilitate the development of general purpose integration mechanisms through the use of ontology-driven translators.

FY 99 Phase 2 Award Winner

TOPIC: 8.10 Chemical Science and Technology

SUBTOPIC: 8.10.2T Strongly Coupled CFD Code for Modeling of Spray Combustion Systems

TITLE: Next Generation CFD Code for Spray Combustion Simulations

FIRM: CFD Research Corporation
215 Synn Drive
Huntsville, Al 35805

PRINCIPAL INVESTIGATOR: M.G. Girdharan
205-726-4800

AWARD AMOUNT: $299,952

ABSTRACT:

Despite major advances in CFD technology over the past two decades, simulation of industrial spray combustion systems remains challenging due to difficulties in modeling various droplet physical phenomena and in dealing with the geometrical complexity. The proposed study will develop a 3-dimensional code incorporating advanced physical models for droplet transport/vaporization and spray combustion by using solution-adaptive unstructured meshes and efficient parallel algorithms.

The Phase 1 effort demonstrated proof-of-concept by developing a baseline spray dynamics module incorporating heat and mass transfer and coupling it with an existing unstructured reactive flow solver. Comparison of model predictions for non-evaporating and burning sprays with experimental data showed good agreement. In Phase 2, the code will be extended to include state-of-the art models for droplet physics, such as multi-component droplets; droplet-turbulence interactions; droplet deformation, breakup and collisions; soot and gaseous emissions; detailed chemical kinetics; and group combustion, and stochastic spray. Additionally, solution-adaptive meshing techniques and algorithm improvements will be incorporated into the code. As part of a verification study, the developed code will be subjected to a series of test cases for which analytical solutions are available. Comprehensive benchmark validation of the code will be performed against data being collected at the NIST Spray Combustion Facility. A variety of full-scale 3-D waste fuel furnace/incinerator simulations will be performed to demonstrate the capabilities of the code. Prof. Aswani Gupta of the University of Maryland and Prof. Clayton Crowe of Washington State University will be consultants during the Phase 2 project. Phase 3 commitments and endorsements have been obtained from Optomec, BMW--Rolls-Royce and Geo-Centers, Inc.

COMMERCIAL APPLICATIONS:

The computer code developed under this study will be a valuable design and analysis tool to maximize the operating efficiency of spray combustion systems and to reduce the formation and release of harmful emissions. This software will have applications in gas turbine and rocket engine combustors, furnaces, evaporative cooling systems, particle separation systems, fire protection systems, chemical/process industries, and particle/dust cleaning systems used in microelectronic applications.

FY 99 Phase 2 Award Winner

TOPIC: 8.10 Chemical Science and Technology

SUBTOPIC: 8.10.6T New Technology Detectors for Analytical X-ray Spectometry

TITLE: New Technology EDS Detectors for X-ray Microanalysis

FIRM: Photon Imaging, Inc.
19355 Business Center Dr. Suite 8
Northridge, CA 91324

PRINCIPAL INVESTIGATOR: Jan Iwanczyk
818-709-2468

AWARD AMOUNT: $300,000

ABSTRACT:

The goal of the proposed work is to develop a novel detector for analytical spectrometry having large active area, high-energy resolution and capable of operating at high counting rates. The proposed detector will be specifically designed for x-ray microanalysis to provide orders of magnitude advancement in the performance over conventional energy dispersive systems. During the Phase 1 effort of this project, we successfully designed, fabricated, and demonstrated a ~2cm^2 silicon drift detector (SDD) array. All of the goals of Phase 1 were met, and most were significantly exceeded. Accomplishments included development of a closely spaced array of four 0.5 cm^2 SDD elements. Energy resolution of 143 eV FWHM at 5.9 keV was achieved on the best device. All four devices produced energy resolution below 200 eV FWHM. Importantly, these results were obtained at relatively short peaking times and additionally the detectors do not require cryogenic cooling to obtain this performance.

In Phase 2, we will develop a prototype x-ray spectrometer for insertion into an electron microscope. The prototype will include the finalized detector array of up to four elements based upon the Phase 1 study. Each element will be capable of attaining electronic noise of <10 e^- rms at peaking times on the order of 100 ns, allowing throughput rates exceeding 10^6 cps each. These advances will have a remarkable impact on reducing the acquisition time for 2-dimensional compositional mapping. The prototype system will be deployed for evaluation at NIST in one of the scanning electron microscope instruments.

COMMERCIAL APPLICATIONS:

The proposed new detectors will lead to significant performance improvements and lower cost systems. Elimination of the liquid nitrogen, combined with the low cost of silicon planar processing, will allow construction of affordable, small mass, low power consumption x-ray analytical systems. These new devices will replace many existing detectors based on cryogenic Si(Li) and High Purity Germanium, used in many commercial (e.g., microanalysis, x-ray fluorescence, x-ray diffraction, medical imaging) and scientific (nuclear, high energy physics, synchrotron radiation experiments) applications. Other new applications are possible for use in hand-held, portable field instrumentation.

FY 99 Phase 2 Award Winner

TOPIC:	8.11	Physics
SUBTOPIC:	8.11.14T	Liquid-Nitrogen-Cooled Electrical Substitution Radiometer
TITLE:		Advanced Absolute Radiometers Using Superconducting Transition Thermometers
FIRM:		CRI, Inc. 80 Ashford Street Boston, MA 02134
PRINCIPAL INVESTIGATOR:		Peter Foukal 617-787-5700
AWARD AMOUNT:		$299,964

ABSTRACT:

In our Phase 1 work we were able to replicate and build on recent results at NIST with superconducting transition (SCT) thermometers, which suggested that dramatic improvements may be achieved in detectivity and range of application, of cryogenic electrical substitution radiometers. Cryo-ESR's are widely used as the most accurate absolute standards of radiative flux and irradiance. In Phase 2, we will focus on the additional research required to demonstrate that the advantages of SCT thermometry can be translated into: (a) LN_2-cooled ESR's of comparable accuracy, but easier accessibility, than conventional, LHe-cooled instruments; (b) LHe-cooled ESR's capable of improved detectivity for detector calibrations in the aerospace industry; and (c) more stable pyrheliometers operating at 90 K for space-borne monitoring of radiations in solar total and ultraviolet irradiance. This research will include development of high-T_c superconducting heater leads having low thermal conductance, of an SCT thermometer based on thin metal films with T_c between 2-4 K, and characterization of a prototype LN_2-cooled ESR through intercomparison with LHe-cooled ESR's at CRI, and calibration at the NIST HACR facility. CRI is the world's leading manufacturer of cryo-ESR's, and identifies total domestic and foreign markets of $10-15 M for this important new technology if the Phase 2 objectives in accuracy and system detectivity can be met.

COMMERCIAL APPLICATIONS:

(1) LN_2-cooled electrical substitution radiometers for absolute measurement of light flux and irradiance, of similar accuracy, but more widely accessible, and less expensive to operate, than conventional LHe-cooled electrical substitution radiometers.

(2) LHe-cooled electrical substitution radiometers capable of ten times higher detectivity than conventional cryo-ESR's, for more widely useful aerospace detector calibrations.

(3) More stable pyrheliometers for NOAA or NASA monitoring of total and UV solar irradiance from space, in global change studies.

FY 99 Phase 2 Award Winner

TOPIC:	8.12	Materials Science and Engineering
SUBTOPIC:	8.127T/CC	Process Monitoring and Control of Composites Processing
TITLE:		Optical Fiber Devices for Composite Process Monitoring
FIRM:		F&S, Inc. P.O. Box 11704 Blacksburg, VA 24062-1704
PRINCIPAL INVESTIGATOR:		Paige Furrow 540-953-4282
AWARD AMOUNT:		$275,000

ABSTRACT:

The primary objective of the Phase 1 program was the development of optical fiber devices and cost-effective signal conditioning systems to produce commercially available composite process monitoring systems. The tasks successfully completed during the Phase 1 effort are as follows: (1) examined the performance requirements of the optical fiber devices and demodulation systems for FT-IR- and fluorescent-based process monitoring systems, (2) fabricated special high-index fiber to operate in the near infrared (NIR) that is compatible with standard fiber optical connection components, (3) designed high-index optical fiber compatible grating fabrication that maintains optical transmission quality in the desired wave-length ranges, (4) designed and fabricated a prototype optical launch system for use with FT-IR systems to monitor epoxy resin cure, (5) designed and fabricated a prototype grating-based optical fiber sensor to monitor resin flow during composite processing, (6) investigated sensor elements for fluorescent applications, (7) designed and constructed cost-effective signal conditioning systems, and (8) demonstrated prototypes at F&S and NIST. The objective of the proposed Phase 2 program is to build upon the success of the Phase 1 effort and produce commercially available cure monitoring instrumentation based on patented F&S technology.

COMMERCIAL APPLICATIONS:

The inherent advantages of on-line and development stage process monitoring made possible using fiber optic systems will enable significant market penetration in the composite industry where structural performance is of major importance. The optimization of curing processes will lead to greater cost-savings; this makes optical fiber instrumentation attractive to composite manufacturers. The multi-billion dollar composite markets include the (1) aerospace, (2) automotive, (3) sporting goods, (4) heavy industry, (5) infrastructure, (6) oil and gas, and (7) government and academic research laboratories. Based on the initial market and competition analysis performed during Phase 1, the F&S team is actively targeting select market opportunities with intent to provide cost-effective process monitoring sensors to composite manufacturers.

FY 99 Phase 2 Award Winner

TOPIC:	8.12	Materials Science and Technology
SUBTOPIC:	8.12.11T	Device and Technique for Measurement of Thermal Conductivity of Ceramic Powders
TITLE:		High-Temperature Thermal Conductivity Measurements of Ceramic Powders
FIRM:		METSYS P.O. Box 254 Millwood, VA 22646
PRINCIPAL INVESTIGATOR:		Daniel R. Flynn 540-837-2186
AWARD AMOUNT:		$275,000

ABSTRACT:

It is proposed to develop an advanced field apparatus for measuring the thermal conductivity of ceramic powders over the range of temperatures from room temperature to 1500 to 2500 K, depending upon the particular material and its compatibility with other materials. The apparatus will have the capability to carry out fully automated thermal conductivity measurements, by transient or steady-state means, under controlled gaseous environments and will be equipped with associated software to compute the thermal conductivity of the ceramic particle material from the data taken on powders. The specific objectives of the Phase 2 effort are: finalize the design of the prototype field apparatus for determination of the thermal conductivity of ceramic powders of mixtures, including construction drawings and selection of all instrumentation; develop software for experimental control, data acquisition, and data analysis for the prototype field thermal conductivity apparatus; further review available correlations and models relating the thermal conductivity of powders and mixtures to the properties of their constituents, and write appropriate software for use with the prototype field thermal conductivity apparatus; and build and test the prototype field thermal conductivity apparatus.

COMMERCIAL APPLICATIONS:

The apparatus design that is being developed, along with the software that will be developed for use with the apparatus, will provide the thermal spray industry with a valuable tool that can be used to select feedstock, based upon its thermal conductivity and other properties, and to optimize the thermal spraying process. The apparatus will be sufficiently inexpensive, and easy to operate, that it can be used by suppliers of feedstock, companies that apply thermally sprayed coatings, and researchers. In addition, the apparatus will be very useful for determining the thermal conductivity of powders used for other purposes, such as thermal insulation or formation of ceramic parts by various manufacturing processes.

FY 99 Phase 2 Award Winner

TOPIC:	8.13	Building and Fire Research
SUBTOPIC:	8.13.4T	Low-Cost, Smart Vibration Sensors
TITLE:		Low-Cost, Smart Vibration Sensor Utilizing CIFMEMS Technology and Postmolded-Plastic (PMP) Packing
FIRM:		OPTICAL E.T.C., Inc. 3077-K Leeman Ferry Road Huntsville, AL 35801
PRINCIPAL INVESTIGATOR:		Jon Geist 301-774-7280
AWARD AMOUNT:		$299,992

ABSTRACT:

The feasibility of a very lost cost approach to producing smart amplication-specific vibration sensors will be investigated. The approach consists of: (1) fabricating integrated circuit wafers containing vibration sensor precursors and signal processing electronics at a commercial Application-Specific Integrated-Circuit (ASIC) foundry service in a completely standard CMOS process; (2) processing the completed wafers to convert the sensor precursors into functional sensors on dies suitable for postmolded-plastic (PMP) packaging; and (3) packaging the dies at a commercial PMP packaging service. Sensor system protyping will be carried out with low-cost multi-project wafer runs and a full-wafer layout will be designed when prototyping is completed. Low-cost test wafers that simulate the sensor-wafer layout will be fabricated and run through steps 2 and 3 to verify that they are working properly. Then a small batch of full wafers will be run through steps 1, 2, and 3. The results will be somewhere between 10,000 and 40,000 single-chip demonstration vibration-sensor systems for testing by potential customers for custom systems.

COMMERCIAL APPLICATIONS:

There is a large untapped market for very low-cost vibration sensors for shutting off malfunctioning air-conditioning compressors to minimize the damage to equipment that is covered by manufacturers warranties. A break-through in vibration-sensor cost is needed to tap this market. The results of the successful completion of this project will be applicable to many other untapped markets for vibration sensors such as condition-based maintenance.

FY 99 Phase 2 Award Winner

TOPIC: 8.13 Building and Fire Research

SUBTOPIC: 8.13.12T Advanced Fire Suppression and Novel Suppression Concepts

TITLE: A Solid-Solid Hybrid Gas Generator Fire Suppression System

FIRM: Mainstream Engineering Corporation
Pines Industrial Center
200 Yellow Place
Rockledge, FL 32955

PRINCIPAL INVESTIGATOR: Lawrence R. Grzyll
407-631-3550

AWARD AMOUNT: $299,771

ABSTRACT:

This Phase 2 proposal addresses the advanced development and commercialization of a novel solid-solid hybrid gas generator fire suppression technology to replace the ozone depleting Halon 1301 for total flooding applications. Mainstream's solid-solid hybrid gas generator technology will result in the delivery of chemical extinguishing agents to the fire in addition to the inert gas agents. This technology has several advantages over state-of-the art gas generator fire suppression technology. First, the system will be significantly smaller and lighter than current gas generator systems because it results in chemical, in addition to physical, extinguishment of the fire. Second, the entire hybrid gas generator material is stored in a single storage vessel as a solid, compared to other hybrid systems which require a separate pressure storage vessel. Third, the hybrid gas generator material has acceptable atmospheric and toxicological properties, unlike other hybrid gas generator systems that use the agents HFC-227ea., HFC-236FA, or CF_3I.

COMMERCIAL APPLICATIONS:

Successful completion of the Phase 2 effort will result in the final development and commercialization of Mainstream's hybrid gas generation fire suppression technology. The Phase 2 effort will show that this technology is superior to other existing technologies in terms of system size, system weight, fire suppression effectiveness, and cost. The technology also has no environmental or atmospheric concerns, making it the ideal future technology for total flood fire suppression.

FY 99 Phase 2 Award Winner

TOPIC: 8.14 Information Technology

SUBTOPIC: 8.14.1T Extending RBAC to Include Work Flow Properties

TITLE: Workflow Policy Server

FIRM: Secure Computing Corporation
2675 Long Lake Road
Roseville, MN 55113

PRINCIPAL INVESTIGATOR: Charles Payne
612-628-1584

AWARD AMOUNT: $299,398

ABSTRACT:

Workflow management systems (WMS) may control access between hundreds of users and thousands of objects, so simplified policy management is critical. WMS developers recommend Role-Based Access Control (RBAC) since roles occur naturally in workflows; however, the typical RBAC model lacks the framework to express workflow policies adequately.

Traditionally, a WMS mediates accesses to objects in its workflows. As workflow technology grows in popularity, workflows eventually may control distributed objects such as managed by CORBA and COM/DCOM. Protections must be added to these objects to prevent users from circumventing the WMS and accessing the objects directly.

We propose the “Workflow Policy Server” (WPS) to address these challenges. The WPS simplifies workflow policy management with a powerful RBAC Model that has been extended with workflow concepts. In particular, the concept of a workflow task or ‘step’ has been added. Distributed objects are protected because the WPS can “push out” the access control policy for a specific stop when directed. The WPS translates the step’s policy into the enforcement language of the target object manager.

COMMERCIAL APPLICATIONS:

Secure Computing provides a wide family of high security products, including firewalls, web filtering software and authentication servers. One of the primary focuses is to provide centralized management of security components throughout the enterprise. Specifying and enforcing work flow policies accurately and easily is critical to enforcing complex business policies at several different locations.

Secure Computing intends to incorporate the work flow technology developed under this program into its suite of network security products.

U.S. DEPARTMENT OF COMMERCE
PHASE 1/2 AWARDS BY STATE

STATE	FY95	FY96	FY97	FY98	FY99	TOTAL
						FY85-99
AK	1/0	0/1	0	0	0	1/1
AL	3/0	2/1	0/1	3/0	0/2	8/4
AR	0	0	0	0	0	0
AZ	2/0	0	0	0	0	2/0
CA	14/6	7/5	6/5	7/2	13/3	79/34
CO	3/1	1/1	2/1	1/1	0/1	18/9
CT	2/1	0/1	2/0	0/1	1/0	11/6
DC	0	0	0	0	1/0	1/0
DE	0	1/0	0	0	0	1/0
FL	1/0	0	0	1/0	2/1	9/1
GA	0	0	1/0	0	0	1/0
HI	1/0	0/1	1/0	3/1	1/1	7/3
IA	0	0	0	0	0	0/0
ID	0	0	1/0	0	0	1/0
IL	1/2	0/1	1/0	0	0	6/4
IN	0	1/0	0/1	0	0	1/1
KS	0	1/0	0	0	0	1/0
KY	0	0	0	0	0	0
LA	1/0	0/1	1/0	1/1	0	5/2
MA	10/3	11/3	4/5	6/0	4/2	61/23
MD	6/1	2/0	6/1	6/2	3/1	36/6
ME	0	0	0	1/0	1/0	2/0
MI	2/1	0	3/0	1/0	1/1	8/2
MN	2/0	1/0	4/0	2/0	0/1	11/1
MO	2/0	0	0	0	2/0	5/0
MS	0	0	0	0	0	2/1

STATE	FY 95	FY 96	FY 97	FY 98	FY99	TOTAL
						FY85-99
MT	0	0	0	0	0	0
NC	0	0	0	0	0	1/0
ND	0	0	0	0	0	0
NE	0	0	0	0	0	0
NH	0	0	1/0	0	1/0	4/2
NJ	0	2/0	2/0	1/1	1/1	11/5
NM	2/1	1/1	5/1	0/2	1/0	14/6
NV	0	0	0	0	0	2/1
NY	4/1	4/1	3/3	2/1	0	20/7
OH	2/0	1/1	4/0	1/1	0	9/3
OK	0	0	2/0	0	0	2/0
OR	1/0	0	0	1/0	0	3/0
PA	1/0	2/0	0	0	2/0	7/0
PR	0	0	0	0	0	0
RI	0	0	0	0	1/0	1/0
SC	0	0	0	0	0	0
SD	0	0	0	0	0	0
TN	0	0	0	0	0	0
TX	1/0	0/1	2/0	3/0	3/1	12/4
UT	0	0	0	0	0	0
VA	6/3	0	4/0	5/2	1/2	28/10
VT	0	0	1/0	0	0	1/0
WA	5/0	1/2	6/1	0/4	0	17/8
WI	0	0	0	0	1/0	2/0
WV	0	0	0	0	0	0
WY	0	0	1/0	0	0	1/0
Totals	73/20	38/21	63/19	45/19	40/17	412/146